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THE MALLORY PROPELLER.

We illustrate a very curious and novel system of fitting screw propellers which has been invented by Col. W. H. Mallory, of the United States. The arrangement is so simple, and our engravings are so clear, that very little description will suffice to make the whole intelligible. Our drawings show the way in which the propeller is fitted to a large steam launch which Col. Mallory has brought to this country from the United States. She is 37 feet long and 9 feet 6 inches beam, a precise copy of what is considered to be the best launch in the American Navy. Her engines are disposed aft. They are horizontal, diagonal, and have cylinders 6½ inches diameter and 8 inches stroke; steam is supplied by a boiler of the locomotive type near the bows of the boat.

The propeller shaft is carried in a hollow fish-shaped casting, as shown, the thrust being taken by a series of steel rings, working between a collar on the shaft and the end of the bearing. The casting is supported on a vertical tube which takes the place of an ordinary rudder. The top of this tube is fitted with a worm wheel, the worm gearing in which is driven at will by a pair of tiny trunk engines, fitted in the space beneath the horizontal steering wheel, as shown. By putting these engines in motion either way the whole casting with the propeller can be slewed round at any angle, or caused to revolve through entire circles.

The screw is driven by a pair of miter wheels within the casting, as shown, the shaft of the horizontal wheel being really the engine shaft. The result of this combination is that the main engines always running in one direction, the boat may be made to perform the most extraordinary evolutions. Thus she will go ahead in the ordinary way. Then by starting the slewing engines the propeller will be swung round to point ahead instead of astern, and the boat will then retrograde, or the screw may be placed at an angle to port or starboard, and the boat will then describe a circle of larger or smaller diameter. We recently witnessed her performance in Victoria Docks. The only movements with which the evolutions of Colonel Mallory's craft can be compared are those of a perfectly trained circus horse. She waltzed round and round, dashed in and out among floating logs,

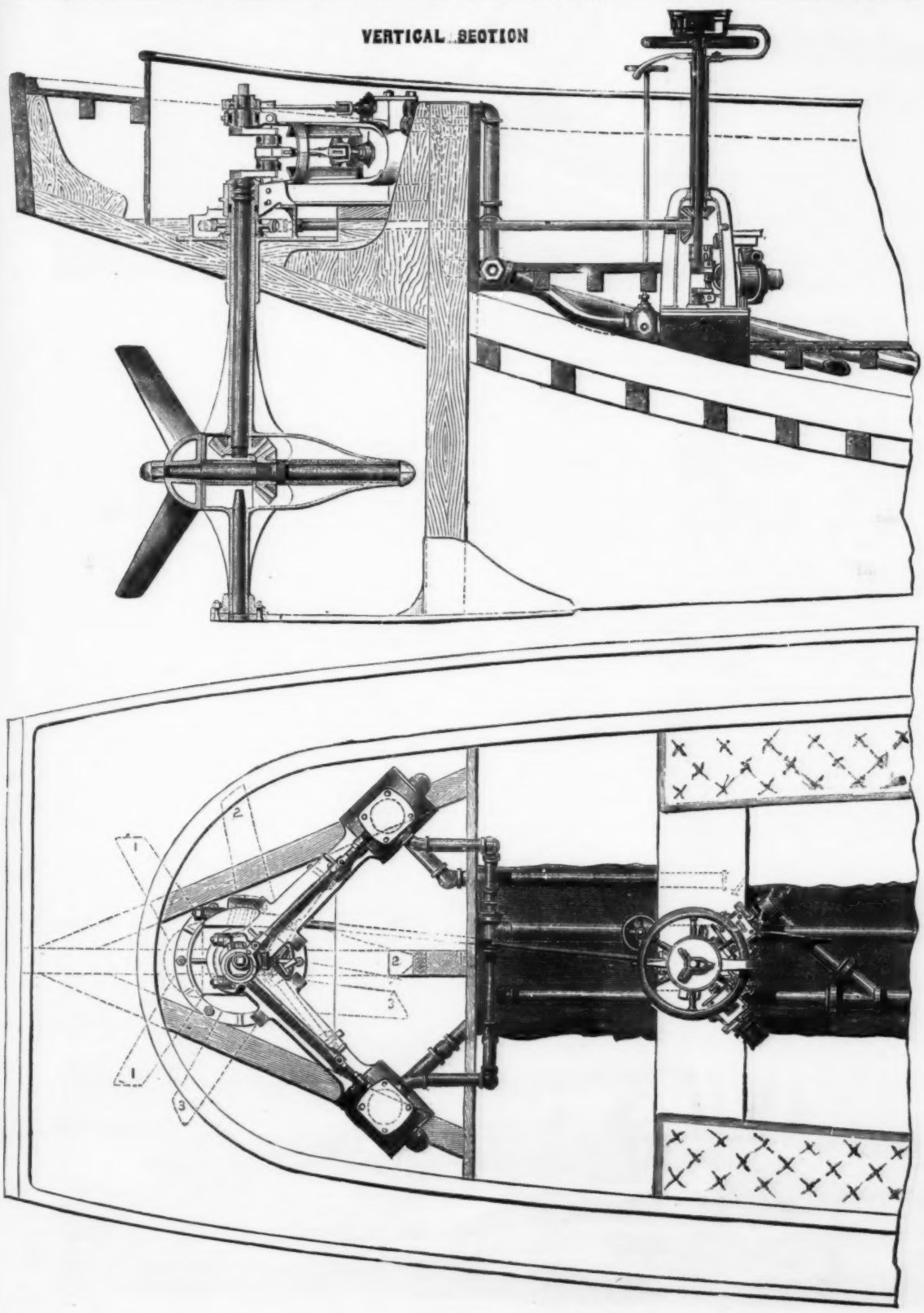


FIG. 1

FIG. 2

FIG. 3

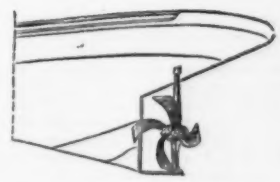
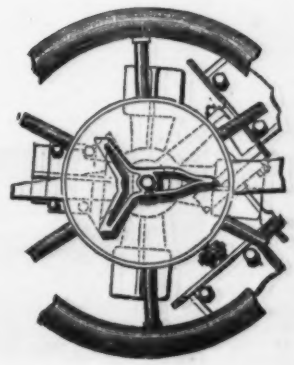


FIG. 4



THE MALLORY PROPELLER.

boats, and steamers, and behaved as no boat of her size ever behaved before. In one word, for any purpose where extreme ease of handling is required, the Mallory system is simply perfection. For example, for tug boats or torpedo boats nothing can be imagined more suitable.

The apparent defect of the system lies in the use of gearing to drive the screw. Colonel Mallory, however, states that as these wheels revolve in water admitted to the hollow casting, a curious action takes place, the water preventing direct contact between the faces of the teeth, and that in consequence the wear and tear are extremely small. The Mallory propeller has been fitted to the yacht Natalie, 95 feet long, 12 feet beam, 7 feet 6 inches depth of hold, and 5 feet 6 inches draught, and this vessel has made about 4,800 miles, the core marks not being worn off the teeth. The American Government have had the invention before them for some time, and are now fitting it to a torpedo ram 175 feet long and 28 feet beam; and we are pleased to find that our own Admiralty regard the invention with favor, and have asked for designs and tenders for three boats. If it be but possible to so manage matters that about 2,000 horse power can be transmitted through the gearing, then the Mallory propeller would be just the thing for the somewhat mysterious ram which the Government are about to build. We heartily advise any of our readers who are interested in screw propulsion to see Colonel Mallory's craft go through her really unprecedented performance—a matter which can be easily arranged by applying to Gen. Joseph R. Hawley, of the United States Army, and 216 Piccadilly, who is introducing the invention into this country. The vertical section and plan speak for themselves. Figs. 1, 2 and 3 show the propeller in various positions, corresponding with the dotted lines in the plan. Fig. 4 is a plan of the steering wheel, on top of which is an index to show the position of the propeller.—*Engineer.*

THE VOYAGE OF THE "NAUTILUS."

This little vessel, which has just traversed the Atlantic, starting from Massachusetts, in forty-five days, is manned by two brothers, named Andrews, respectively a pianoforte maker and a joiner, who have never been to sea before, but have only undertaken coasting trips in fishing boats. Although not the smallest boat which has performed the voyage—that honor being claimed by the City of Ragusa—the Nautilus only measures some nineteen feet in length, is a little over six feet in breadth, is two feet three inches in depth, and draws six and a half inches of water. She is decked throughout, with the exception of a small aperture for entrance, and was ballasted with fresh-water casks, which were filled with sea water as they became emptied. The Nautilus and her adventurous crew left City Point on June 7th, but next day were obliged to put back to Beverly, Mass., owing to the damage sustained through a heavy gale. On June 12th, however, the little vessel fairly started on her voyage, which, although arduous, was altogether not unenjoyable, though, as the elder brother remarks in his log, "Keeping your eyes on the compass throughout a foggy night and watching for lights, blowing fog-horns, wet and cold, without relief, watching the seas as they follow you, thinking now and again you might strike a log which would make a hole through your half-inch cedar, is a novelty not altogether to be desired." Heavy weather and fogs were encountered during a great portion of the voyage; but several vessels were spoken with—the captain of an English schooner insisting upon the two brothers dining with them. On July 28th a storm drove the Nautilus up the St. George's Channel, and in the evening Bishop's Rock was sighted. Next day the two brothers attempted to weather Lizard Point, but failed, owing to a strong northeasterly wind, so they put back into Mullion Cove, and, for the first time, landed on British soil. The Nautilus has now gone to Paris—the original intention of the brothers Andrews being a visit to the Paris Exhibition.

THE AMERICAN BOAT, "NAUTILUS," WHICH RECENTLY CROSSED THE ATLANTIC.

REVIEW OF IRONCLAD SHIPS AND TORPEDO BOATS, ENGLAND.

We give opposite engravings of the Royal Naval Review, Spithead, Eng., August 13th, 1878, which will be interesting as showing on one page the general appearance of many of the strongest and most celebrated war ships of the English Navy. The dimensions, armaments, and engine particulars of several of these ships have been published in the back numbers of our Supplement. Our engravings of the Naval Review are from the *Graphic;* the picture of the torpedo boat below is from the *Illustrated London News.*

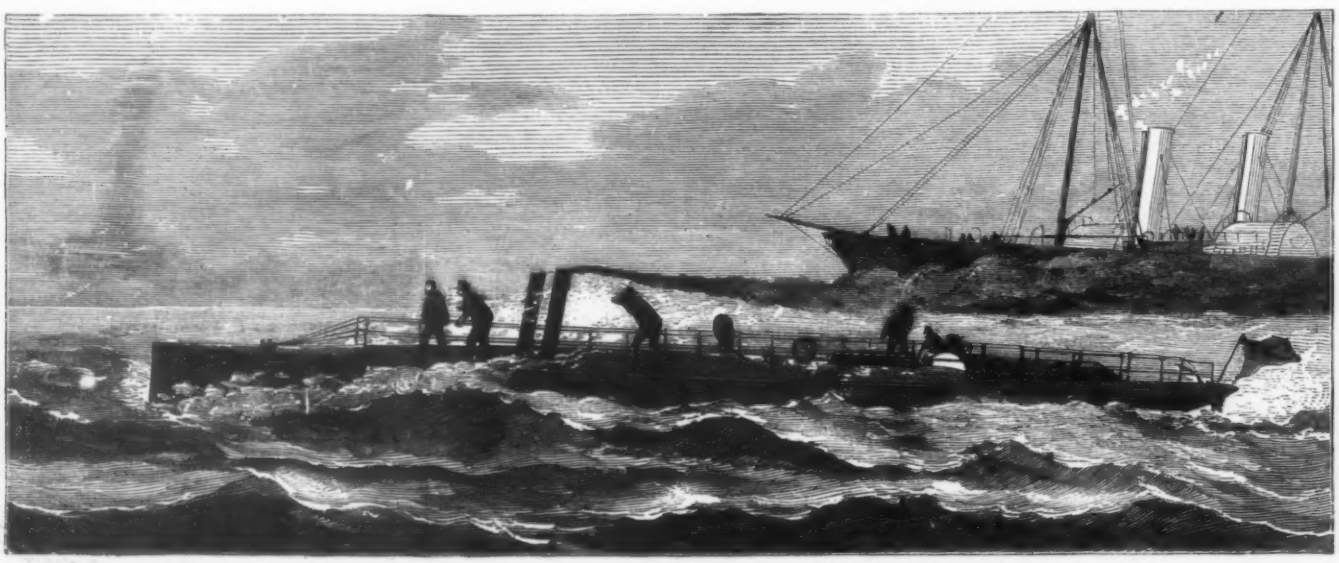
The Queen and all the spectators were very much pleased with the performance of two torpedo boats, one of which is shown below, which have been purchased by the Admiralty from their builders, Messrs. Yarrow & Co., of Poplar. Upon another occasion His Royal Highness the Prince of Wales inspected one of the nimble little vessels, and went on board of her for a brief experience of their wonderful swiftness. These boats in their trial trips at Long Reach about six weeks ago attained a mean speed exceeding twenty-one knots, or twenty-four statute miles, an hour. They are each 85 ft. long, with 11 ft. beam, and draw, when fully equipped for service, an average of 3 ft. of water. They are strongly constructed of steel, and are fitted with compound surface condensing engines capable of indicating 420 horse power. The high-pressure steam cylinder of these engines is 12½ ins. in diameter, and the low-pressure 21½ ins., both having a 12-in. stroke.

These boats are at present known by their builders' numbers, one being No. 419, and the other No. 420. The former is propelled by a three-bladed screw 5 ft. 6 ins. in diameter and 5 ft. pitch, and the latter by a two-bladed screw of similar proportions. Messrs. Yarrow adopt supplementary engines for driving the air pump, circulating pump, and feed pumps, they consider this plan preferable to that of working these pumps direct off the main engine, as is sometimes done. One advantage in having separate pumping engines is that whether the vessel is in motion or stationary a powerful means is available for pumping her out should the necessity arise. It is estimated by her builders that if the air pump and circulating pump were both utilized for this purpose the water could be pumped out as fast as it could enter either of these vessels through one hundred holes made in the skin by Martini-Henry rifle bullets. If this be the case, these craft may be deemed safe from sinking so long as their machinery is working efficiently. The boiler is of the locomotive type, is placed in the forward part of each vessel, and has a closed stoke hole. In connection with the boiler a very important improvement has been introduced by Messrs. Yarrow. This consists in a means of rendering the closed stoke hole safe for the men in the event of the collapse of a boiler tube, a contingency which cannot be absolutely guarded against.

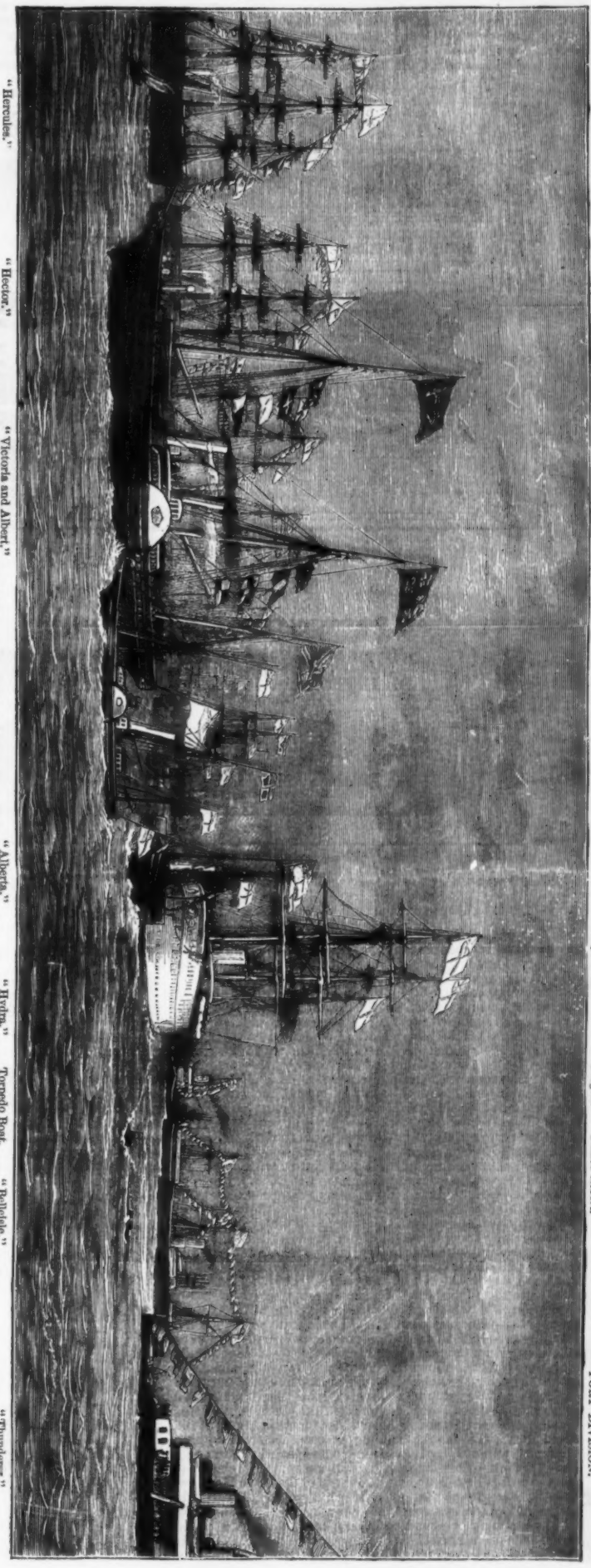
The engines are placed amidships, and each vessel has spacious cabin accommodation aft, as it is intended that they may be used either as dispatch or torpedo boats. For the latter purpose the cabin framings above deck are removed and replaced by steel plating. These vessels are in fact now fitted one for one purpose and one for the other. They are steered from the cabin, there being a look-out for the steersman just above deck level. The deck is clear of all obstructions, the two funnels being placed one on each side. They are fitted with balanced rudders, and steer well, answering their helms very quickly.

THE STEERING OF SCREW SHIPS.

The report of the committee, consisting of Mr. James R. Napier, Sir W. Thomson, Mr. Froude, Mr. Bottomley and Professor Osborne Reynolds, appointed by the British Association to investigate the effect of propellers on the steering of vessels, has been laid before the association at Dublin. The report contains some extraneous matter of little scientific value. The general conclusions arrived at are that all experiments which have been made during the last year, without a single exception, confirm the results obtained in the previous trials made by the committee. But this, say the



SWIFT TORPEDO.—TORPEDO BOATS OF THE BRITISH NAVY.

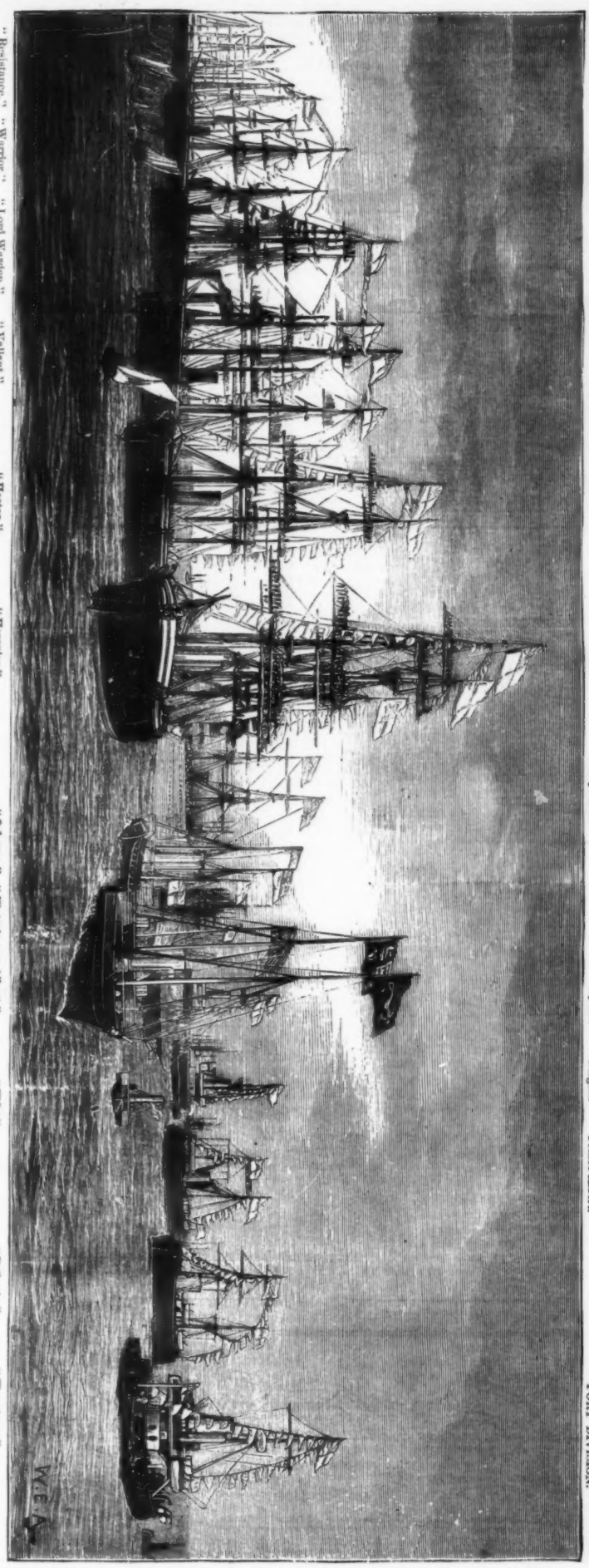


"Hercules." "Victoria and Albert." "Alberta." "Hydra." Torpedo Boat. "Belleisle." "Thunderer."

THE RECENT NAVAL REVIEW AT SPITHEAD.—THE ROYAL YACHT LEAVING THE FLEET.

Signal Flying—"Her Most Gracious Majesty the Queen is much pleased, and regrets extremely that the bad weather has prevented the evolutions."

STARBOARD DIVISION. "Euphrates." "Gorgon." "Prince Albert." PORT DIVISION.



"Resistance." "Warrior." "Lord Warden." "Valiant." "Hector." "Hercules." "Osborne." "Victoria and Albert." "Elfin." "Belleisle." "Thunderer."

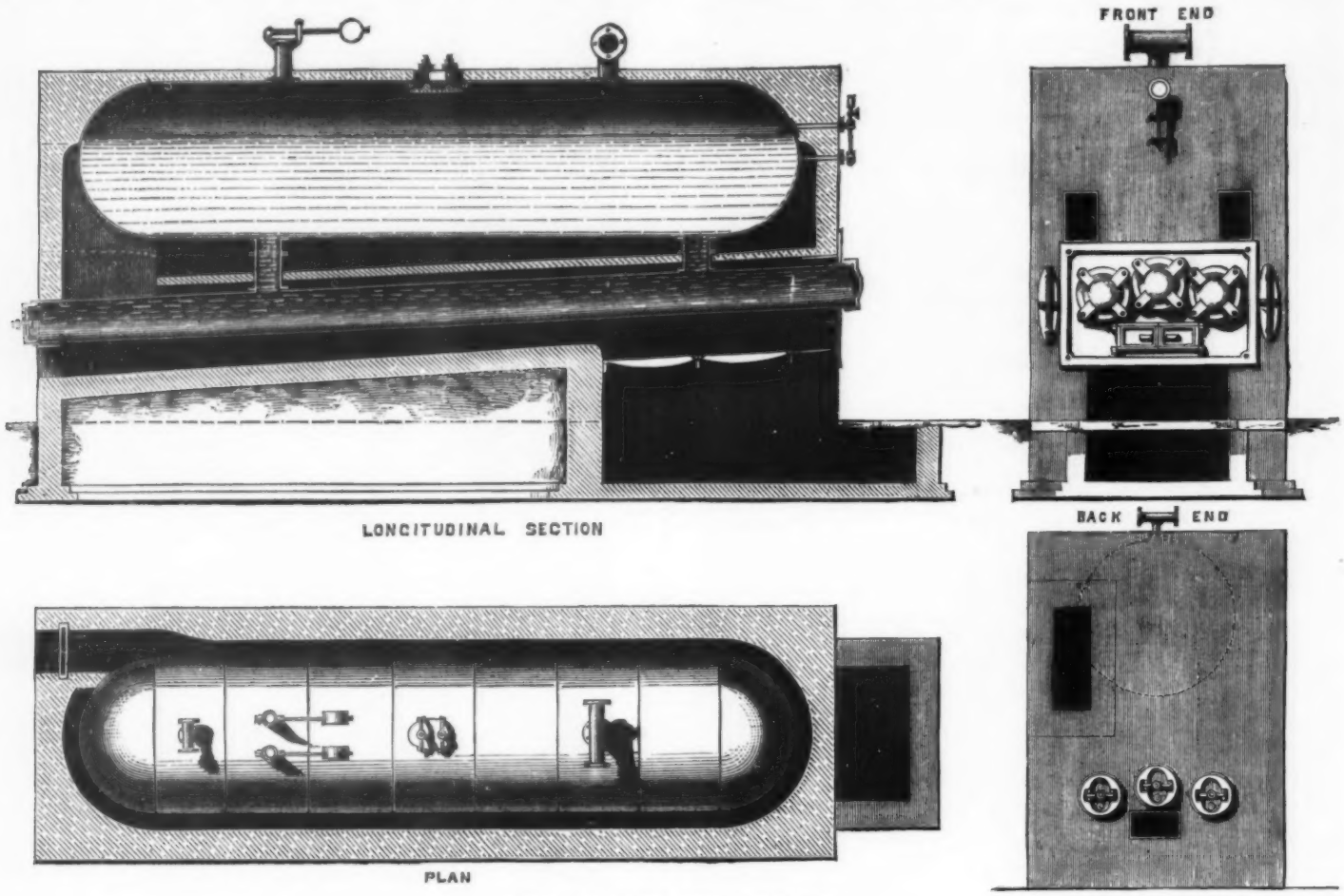
THE RECENT NAVAL REVIEW AT SPITHEAD.—THE ROYAL FLOTILLA PASSING THROUGH THE LINES.

committee, is not the most important purpose which this year's trials serve. For as regards the general effect of the reversed screw on the action of the rudder, the trials already reported, particularly those of the Hankow (see last year's report), are conclusive and leave nothing to be desired. But the previous trials were all made with fast vessels at their full draught, their screws being well covered and the conditions of the weather being most favorable. The trials this year, on the other hand, appear for the most part to have been made with vessels in light trim, and in two instances the wind was blowing with considerable force. The result of these circumstances on the behavior of the vessels is very decided, and coincides remarkably with the effects deduced by Prof. Reynolds from his experiments on models, viz., that when the screw is not deeply immersed and froths the water, it exerts, when reversed, considerable influence to turn the vessel independently of the rudder; the vessel turning to starboard or port according as the screw is right or left handed, which effect—and this seems to be the point most generally unknown—nearly disappears when the screw is so deeply immersed that it does not churn air into the water.

It appears, both from the experiments made by the committee and from other evidence, that the distance required by a screw steamer to bring herself to rest from full speed by the reversal of her screw, is independent, or nearly so, of the power of the engines, but depends on the size and build of the ship, and generally lies between four and six times the ship's length. It is to be borne in mind that it is to the behavior of the ship during this interval that the following remarks apply. The main point the committee had in view has been to ascertain how far the reversing of the screw in order to stop a ship did or did not interfere with the action of the rudder during the interval of stopping, and it is as regards this point that the most important light has been thrown on the question of handling ships. It is found an invariable rule that, during the interval in which a ship is stopping herself by the reversal of her screw, the rudder produces none of its usual effects to turn the ship, but that, under these circumstances, the effect of the rudder, such as it is, is to turn the ship in the opposite direction from that in which she would turn if the screw were going ahead. The magnitude of this reverse effect of the rudder is always feeble, and is different for different ships, and even for the same ship under different conditions of loading. It also appears from the trials that owing to the feeble influence of the rudder over the ship during the interval in which she is stopping, she is then at the mercy of any other influences that may act upon her. Thus the wind, which always exerts an influence to turn the stem—or forward end—of the ship into the wind, but which influence is usually well under control of the rudder, may, when the screw is reversed, become paramount and cause the ship to turn in a direction the very opposite to that which is desired. Also,

the reversed screw will exercise an influence, which increases as the ship's way is diminished, to turn the ship to starboard or port according as it is right or left-handed; this being particularly the case when the ships are in light draught. These several influences, the reversed effect of the rudder, the effect of the wind, and the action of the screw, will determine the course the ship takes during the interval of stopping. They may balance, in which case the ship will go straight on; or any one of the three may predominate, and determine the course of the ship. The utmost effect of these influences when they all act in conjunction—as when the screw is right-handed, the helm starboarded, and the wind on the starboard side—is small as compared with the influence of the rudder as it acts when the ship is steaming ahead. In no instance has a ship tried by the committee been able to turn with the screw reversed on a circle of less than double the radius of that on which she would turn when steaming ahead. So that even if those in charge could govern the direction in which the ship will turn while stopping, she turns but slowly, whereas, in point of fact, those in charge have little or no control over this direction, and unless they are exceptionally well acquainted with their ship they will be unable even to predict the direction. It is easy to see, therefore, that if on approaching danger the screw be reversed, all idea of turning the ship out of the way of the danger must be abandoned. She may turn a little, and those in charge may know in which direction she will turn, or may even, by using the rudder in an inverse manner, be able to influence this direction, but the amount of turning must be small and the direction very uncertain. The question, therefore, as to the advisability of reversing the screw is simply a question as to whether the danger may be better avoided by stopping or by turning. A ship cannot do both with any certainty. Which of these two courses it is better to follow must depend on the particular circumstances of each particular case; but the following considerations would appear to show that when the helm is under sufficient command there can seldom be any doubt. A screw steamship when at full speed requires five lengths, more or less, in which to stop herself; whereas, by using her rudder for steaming on at full speed ahead, she should be able to turn herself through a quadrant without having advanced five lengths in her original direction. That is to say, a ship can turn a circle of not greater radius than four lengths, more or less—see Hankow, Valetta, Barge*—so that even if running at full speed directly on to a straight coast, she should be able to save herself by steaming on ahead and using her rudder after she is too near to save herself by stopping; and any obliquity in the direction of approach or any limit to the breadth of the object ahead is to the advantage of turning, but not at all to the advantage of stopping. There is one consideration, however, with regard to the question of stopping or turning which must, according to the present custom, often have weight, although there can be but one opinion as to the viciousness of this custom. This consideration is the utter inability of the officers in charge to make any rapid use of their rudder so long as their engines are kept on ahead. It is no uncommon thing for the largest ships to be steered by as few as two men. And the mere fact of the wheel being so arranged that two men have command of the rudder renders so many turns of the wheel necessary to bring the rudder over, that even where ready help is at hand it takes a long time to turn the wheel round and round so as to put a large angle on the rudder. The result is that it is often one or two minutes after the order is heard before there is any large angle on the rudder, and of course, under these circumstances, it is absurd to talk of making use of the turning qualities of a ship in case of emergency. The power available to turn the rudder should be proportional to the tonnage of the vessel, and there is no mechanical reason why the rudder of the largest vessel should not be brought hard over in less than fifteen seconds from the time the order is given. Had those in charge of steamships efficient control over their rudders, it is probable that much less would be heard of the reversing of the engines in cases of imminent danger.

* B. A. Reports, 1876-77.



THE ELEPHANT BOILER.

ELEPHANT BOILERS.

More than fifty years ago the late Mr. E. Hall, recognizing, as you have done, the clever arrangement of this French boiler, brought the design over to England, and from that time until now, when the selection is left to us, we recommend, as a rule, this description in preference to others. Its qualifications are cheapness, simplicity of construction, durability, safety, and facility for cleaning. We can show now boilers of this design still at work that were made forty years ago, and, out of the large number that we have erected, we are pleased to say not one has ever exploded. Any coal or sawdust will suffice for them, and, as the fire is all external, there is no danger from collapsing flues. Used in conjunction with our compound condensing engine, we know that even in India, with the inferior native coal, only 2½ lbs. are consumed per horse power per hour. It is quite refreshing to find our old-fashioned notions receiving such high commendation at the hands of the editor of the *Engineer*, and we welcome the aid of your able pen in rebutting the doctrine that, as a matter of course, old inventions must be less valuable than those of a later date, and that novelty is always synonymous with improvement. We inclose a drawing of the design we are now making, which, while retaining the essential qualifications, differs from the original in one or two minor but still important points.

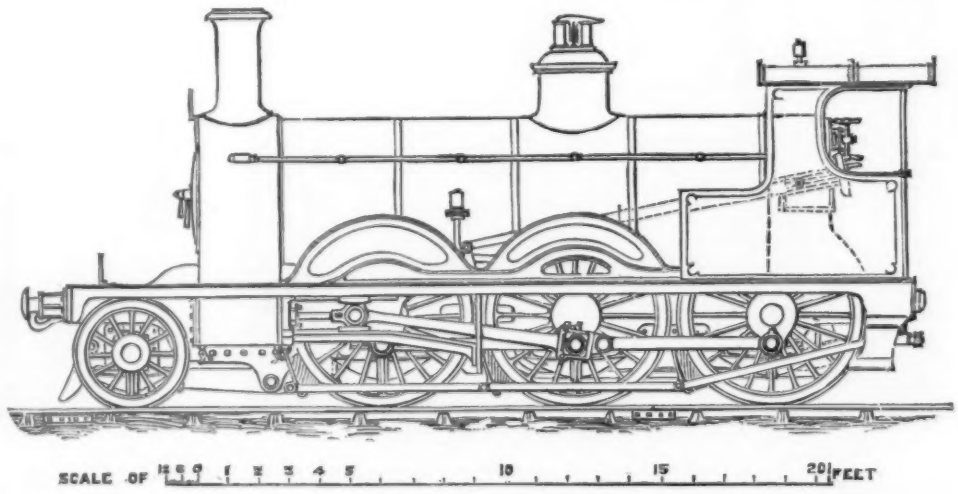
John and Edward Hall.

Dartford Iron Works, Dartford, Eng.

ENGLISH SIX-COUPLED EXPRESS ENGINE.

By E. Lewis Pearce.

The boiler, which has a heating surface of about 1,300 square feet, would amply supply cylinders 19 ins. diameter by 22 ins. stroke, which, acting upon driving wheels 5 ft. 10 ins. diameter, would give 110 lbs. tractive force for each pound of cylinder pressure. If more tractive force is necessary, I should suggest cylinders 19 ins. by 24 ins., and 6 ft. driving wheels, 120 lbs. tractive force. The rigid wheel base in the engine illustrated is 12 ft. 6 ins.; total wheel base, 20 ft. 9 ins.—*Engineer.*



ENGLISH SIX-COUPLED EXPRESS ENGINE.

THE SAFETY OF STEAM TRANSIT.

The *Railroad Gazette* remarks that the dangerousness of horse railroads is not usually considered. Steam railroads have been likened to war and pestilence, but your easy-going and unobtrusive street car is counted perfectly safe. But by the last report of the State Engineer and Surveyor, it seems that the horse railroads are considerably the more dangerous of the two. Counting the average passenger journey on a street car as two miles (and it certainly was not more than that), one passenger was killed for every 121,018,-'08 miles traveled, and one killed or injured for every 8,346,076 miles on the horse roads, while on the steam roads 147,054,019 miles were traveled to one killed, and 18,715,966 to one killed or injured. If you wish to be safe, put not your trust in horses, but get behind a locomotive. There was

absolutely, in the year covered by the report, a larger number of passengers injured on the horse railroads than on the steam roads (54 to 48), but the killed were seven on steam to four on horse roads, the aggregate distance traveled by steam being (estimating two miles as the average horse car journey) something more than twice as great as that traveled by horse roads. This refers to passengers alone; the employes and others killed and injured by steam roads greatly outnumber those on the street roads. But the steam roads have a mileage of freight trains four-fifths greater than their passenger train mileage, for which there is nothing corresponding on the street roads, to say nothing of number of vehicles, etc.

It will probably astonish most readers to learn that the passenger mileage on the 451 miles of street railroads was anything like half as great as on the 8,131 miles of steam railroads worked during the year. Yet it was nearly, providing that this estimate of two miles for the average journey is not too much, and the average passenger traffic per mile of road was *eight times as great* on the horse as on the steam roads (1,073,229 passenger miles to 126,599).

BRITISH ASSOCIATION, DUBLIN MEETING—ABSTRACTS OF PAPERS.*

BABBAGE'S ANALYTICAL ENGINE.

THE report of the committee, after describing the principle of the machine, states that it has not been possible to form any exact conclusion as to the cost. Nevertheless there are some data in existence which appear to fix a lower limit to the cost. Mr. Babbage, in his published papers, talks of having 1,000 columns of wheels, each containing 50 distinct wheels. This apparently refers to his "store." Besides the many thousand moulded pewter wheels for these and the axes on which they are mounted there is the "mill," also consisting of a series of columns of wheels and of a vast machinery of cams, clutches and cranks for their control and connection, so as to bring them within the directing power of the Jacquard systems of variable cards and operation cards. Without attempting any exact estimate, the committee say that it would surprise them very much if it were found possible to obtain tenders for less than £10,000, while it would cost a considerable sum to put the design into a fit state for obtaining tenders. On the other hand, the cost might reach three or four times the amount above suggested. It is understood that toward the close of his life Mr. Babbage had contemplated carrying out the manufacture of the engine on a smaller scale, confining himself to 25 figures instead of 50, and to 200 columns instead of a thousand or more. This would, of course, reduce the expense of the metal work proportionately, but not materially. The conclusion at which the committee arrived was that they could not advise the British Association to take any steps to procure the construction of Mr. Babbage's analytical engine.

UNDERGROUND WATER.

The report of the Underground Water Committee was read by Mr. De Rance. The value of the maps of the Government Geological Survey as a basis for investigation in questions of water supply was commented on, and the area occupied by permeable formations capable of yielding water in wells sunk in suitable situations was stated to be no less than 26,687 square miles, which, receiving a rainfall averaging 30 inches a year, would yield up to wells not less than 249,000 gallons per day for each square mile of surface, or a total quantity far in excess of that required by the population of England and Wales.

The great value of these supplies for the towns and districts of the midland counties was insisted on, for their purity, and from the absence of the strong Parliamentary opposition which is encountered in all large gravitation schemes, whether the water be proposed to be taken from natural lakes, as the Thirlmere scheme for Manchester, or from artificial reservoirs, as the proposal to take the sources of the Severn for Liverpool. The well-boring at Bootle, near Liverpool, 26 inches in diameter, just completed for the Liverpool Corporation by Messrs. Mather & Platt, was described as of great interest, the boring having reached a depth of 1,000 feet without reaching the base of the new red sandstone. The committee express a hope that this boring will be continued, as it will settle several questions not merely of local interest, but of national importance, as the water bearing capabilities of the lower beds of the new red sandstone at great depths, the character of the coal measures which undoubtedly underlie Liverpool, and the depth to them. Among a large number of other wells and borings alluded to was one at Burford, near Oxford, where the coal measures, with a coal-seam, were found present under the oolitic and triassic strata.

THE PEDETIC ACTION OF SOAP.

Prof. W. Stanley Jevons read a paper on this subject, in which he said: Since the publication of my paper on Pedesis, or the so-called Brownian movement of microscopic particles, it has been suggested to me that soap would form a good critical substance for experiment in relation to this phenomenon. Having tried the experiment, I find that with a solution of common soap the pedetic motion becomes considerably more marked than before. I have observed this result not only with china clay and some other silicates, but also with such comparatively inert substances as the red oxide of iron, chalk and even the heavy powder of barium carbonate. The last named substance, one of those which we should least expect to dance about of its own accord, gave a beautiful exhibition of the movement when mixed with a solution of about 1 per cent. of soap, and viewed with a magnifying power of 500 or 1,000 diameters. The correctness of this result was also tested by observing the suspending power of solutions of soap-solution compared with water. If a little china clay be diffused through common water the greater part of the clay will soon be seen to collect together in small flocks and fall to the bottom, in two or three hours the water being almost clear. However, if about one per cent. of soap be dissolved in the water the behavior of the clay is quite different. The larger particles subside, but the smaller ones remain diffused through the liquid for a long time, giving it a milky appearance, quite different from the flocky and grainy appearance of the common water. If 1 per cent. of sodium carbonate be dissolved in common water, and china clay be mixed therewith, the subsidence of the clay is still more rapid, owing, as I have explained, to the electric increase in the conductivity of the fluid, and the consequent decrease of pedesis. But I now find that if soap be added at the same time, pedesis is not destroyed but much increased, and the clay remains a long time in suspension, two or three days at least. These facts give a complete explanation of the detergent power of soap. It has long seemed to me unaccountable that for cleansing purposes the comparatively neutral soap should be better than the alkaline carbonate by itself; we are told that the alkali is but feebly combined with the stearic or other fatty acids. But why combine it at all if we need only the alkaline power of the base? The fact is that the detergent action of soap is due to pedesis, by which minute particles are loosened and diffused through the water so as to be readily carried off. Pure rain or distilled water has a high cleansing power, because it produces pedesis in a high degree. The hardness of impure water arises from the vast decrease of pedesis due to the salts in solution. Hence the inferior cleansing power of such water. If alkaline salts be added, dissolved in water, it becomes capable of acting on oleaginous matter, but the pedetic power is lessened, not increased. But if soap be added also, we have the advantage both of the alkali dissolving power and of the pedetic cleansing power. At the same time we have a clear explanation why silicate of soda is now used in making soap; for I have shown, in the paper referred to, that silicated soda is one of the few universal substances which increase the pedetic and suspensive action of water.

* *English Mechanic.*

INSTRUMENT FOR DETERMINING THE PRESENCE OF FIRE-DAMP IN MINES.

Prof. G. Forbes read a paper describing an instrument for detecting fire-damp. The instrument consists of a resonator of variable dimensions, and a tuning fork of definite pitch. The resonator is a metal tube 1 inch in diameter, and 15 ins. long, in which a piston slides so as to regulate the length of the tube. This tube is fixed in a block of wood, to which is attached a tuning fork whose points are just above the open end of the tube. The tuning fork is sounded in any convenient way, and the piston is moved out and in till the proper length is found, which is indicated by the resonator intensifying the sound of the tuning fork. With practice the length can be determined with tolerable accuracy. But the length depends upon the density of the gas, a light gas requiring a longer resonator, and by reading off on a scale the position of the piston a person can judge of its density. In this manner 1 or 2 per cent. of fire-damp mixed with common air, can be detected. Barometric pressure produces no difference on the instrument. The temperature correction is made by reading off a thermometer of the proper dimensions, instead of reading off a fixed mark on the piston. The only error possible is by the presence of dense carbonic acid gas. But carbonic acid gas tends to destroy the explosive character of fire-damp, and it appears that if the presence of carbonic acid prevented the instrument from indicating fire-damp, it would certainly be sufficient to prevent the explosive character of the fire-damp.

The Chairman (Father S. J. Perry) said that if the authorities in mines would pay attention to the indications of barometers and thermometers, he believed there would be fully 75 or 80 per cent. of the lives saved; but it seemed impossible to get them to do that. The instrument which Prof. Forbes had described would be exceedingly useful for persons going through the mines, enabling them to find out what was going on, and therefore to take immediate precautions.

Prof. S. P. Thompson said the liberation of gas took place, not so much when the barometer was low, as when a sudden fall occurred. Long continuance of low pressure did not necessarily produce an explosion. He did not see how Professor Forbes' instrument would help miners very much if they neglected the barometer, for the gas which caused the dangerous explosions would not at once mix with the air; there would be currents, and unless it was known in what particular part of the mine to apply the instrument it would be useless in the hands of people who were so careless with the appliances they already had.

A CLOCK WITH A DETACHED TRAIN.

Prof. G. Forbes said: In the course of some experiments still progressing I have used a clock to give electric signals every second. It has a train of only one wheel working in a pinion. It is driven by a weight which falls through 5 feet in an hour This clock only goes one hour, but serves the purpose for which it was made. I wished lately, however, to make it go for a longer time, so I drove it by a weight hung by a pulley on an endless chain in the usual way, and I attached a common 5s. Swiss alarm clock to the chain to wind it up continuously. This answers so well that I would suggest a similar construction as not only the cheapest but also the best form of a clock with escapement. It consists of a pendulum and escapement with no train whatever, with an endless chain or thread passing over a pulley on the axles of the 'scape wheel, and over the minute-wheel of a secondary clock hanging between them in a festoon which supports the weight by a pulley. The secondary clock gives the hours and minutes, and the clock without train shows the seconds. We thus have a clock without the errors introduced by a train. It is a gravity escapement without the locking friction.

EDMONDS' PHONOSCOPE.

This little instrument, the phonoscope, is for producing figures of light from vibrations of sound, and was described by Mr. Ladd. It consists essentially of three parts—an induction coil, an interrupter, and a rotary vacuum tube. The action of the instrument is as follows: Sounds from the voice or other sources produce vibrations on the diaphragm of the interrupter, which, being in the primary circuit of the induction coil, induce at each interruption a current in the secondary coil, similar to the action of a contact breaker or rheotome; therefore each vibration is made visible as a flash in the vacuum tube. The tube revolving all the time at a constant speed, the flashes produce a symmetrical figure, like the spokes of a wheel, as in the Gassiot Star. The number of spokes or radii is according to the number of vibrations in the interrupter during a revolution of the tube, and on the number of vibrations being varied to any extent according to the sounds produced the figures in the revolving tube will be varied accordingly. The same sounds always produce the same figures, providing the revolution be constant. In cases of rhythmical interruption being produced in a given sound, as in a trill, most beautiful effects are noticeable, owing to the omission of certain radii in regular positions in the figure.

BINAURAL AUDITION.

Professor Silvanus P. Thompson read a paper on "Binaural Audition," in which he narrated the results of a long series of experiments on hearing with the two ears. The author has discovered that we possess a perception of the interference of sound; as the following experiment shows: If two tuning forks in unison be put slightly out of tune, so as to show "beats," and their tones be led separately to the two ears with pipes of India rubber, the beats are still to be heard through the two sets of actual vibrations, and never have the opportunity of uniting. Since the discovery of this phenomenon many persons who had experimented with the telephone, including Professor Graham Bell and Sir William Thomson, had observed the same thing. Another phenomenon observed first by means of tuning forks and India rubber tubes, and afterward by means of telephones and the microphone, was that when two sounds reached the two ears in opposite phases, so that the drum skin of one ear was moved forward when that of the other was moved backward, the sound was no longer heard in the ears, but apparently localized at the back of the head. Professor Thompson's principal experiments during the year had been directed to this singular localization of the sound. He had carefully investigated the effect of varying the pitch, the intensity and the quality of the sounds so led to the ears, and had found them to be independent of pitch. With incomplete difference of phase the effects were of a somewhat mixed character. It was also demonstrated that this discovery afforded a method of analyzing compound sounds by bringing them to the two ears by two tubes of unequal length; for when the difference in their lengths amounted to half the length of the wave of any one component, that component was singled out and localized at the back of the head. So, in binaural audition, a difference could be perceived between two compound tones which differed only in the phase, but not in the pitch or the intensity of their components; contradicting the assertions of Helmholtz and Sedley Taylor.

THE ANTIQUITY OF MAN.

Mr. Tiddeman read the sixth report on the exploration of the Victoria Cave, situated about twenty miles north of Leeds. The committee had to make an important announcement—viz., that Prof. Busk had changed his opinion in regard to the Victoria Cave bone, which he had formerly stated to be human. Professor Busk was now of opinion that the bone was ursine, and not human. This bone presents the strongest possible resemblance to a rather abnormal recent human fibula in the College of Surgeons, and was also considered not unlike the fibula in the famous Mentone skeleton. It was therefore considered to be an undeniable proof of the co-existence of man with the extinct mammals in Yorkshire. This was not the only bone found in the Victoria Cave which was supposed to have a bearing on the antiquity of man, and his existence in Britain before the last great cold period had passed away. Many bones were found in the cave cracked and split, as was the custom with savages to split them for the extraction of marrow. It is not easy to explain away the evidently artificial marks upon the other small bones found in the cave.

Prof. Boyd Dawkins wished to enter his emphatic *caveat* against the antiquity of man being grounded on anything yet found in the Victoria Cave. He had studied all its phenomena, and he could not allow the report of the committee to pass without expressing his dissent from the main points contained in it. As to the general question of the antiquity of man, it was one which was being still fought out in Europe and America, and in support of the supposed enormous antiquity of man a very great amount of very unworthy evidence was being in many cases put forward. The evidence of the antiquity of man was at one time based on the discovery of this fibula which was found while he was in charge of the cave. It was of such an uncertain character that he had not dared to have anything to say to it, but Prof. Busk undertook to say that it was a human fibula. It was on the authority of Prof. Busk that it had been set down in his (Prof. Dawkins') book, "Cave Hunting," as a human fibula. On the contrary, he (Professor Dawkins) disclaimed all responsibility for the human character assigned to the fibula, and from the examination of certain ursine bones in France, in Italy, and in the Museum at Cambridge, he saw at once that this fibula, on which the vast antiquity of the human race was supposed to depend, was not of a human but of an ursine character. The next point relied on was that of the cuts on bones. These cuts were certainly made by some metallic-edged tools—he could not say whether steel, or bronze, or iron. But the bones on which these cuts were found did not, in his opinion, belong to any extinct animals or rare animals, but might very well belong to an ordinary bit of leg of mutton or of goat. So much for the cuts on the bones. A very important point had been raised by Mr. Tiddeman as to the antiquity of sheep or goats in Europe, and on this there was a vast amount of evidence. In the first place, none of the caves in the country which had been scientifically explored (leaving the Victoria Cave out of consideration) had presented a single example of the presence of the remains of sheep or goats in association with the remains of extinct animals. The same thing might be said of the caves of France, of Switzerland, and of Italy, and in no caves of Germany was there, as far as he knew, the slightest evidence to associate sheep or goats with any of the extinct animals. The general drift of all the evidence was to show that sheep and goats were not living at the same time with the now extinct animals. Supposing that man was living in association with the extinct animals, what was the age of the extinct animals? On that point doctors differed. Whether or not they belonged to the post-glacial period was an open question, and so even if it was assumed that man was living at that period of the extinct animals, there was no evidence that dated back to the pre-glacial or inter-glacial periods. Small scraps of bone, as big as one's finger, with alleged artificial cuttings, which could otherwise be explained, did not constitute sufficient evidence on which they would be justified in stretching back the antiquity of man to far distant unknown eras.

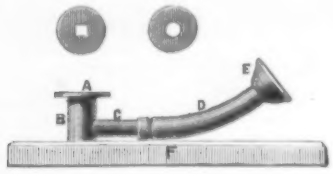
(To be Continued.)

ROSENSTHIEL ON THE "ABSOLUTE" OR "IDEAL BLACK."—M. Chevreul.—The author quotes a passage written in 1835: "If the light falling upon a body is completely absorbed by such body, so as to disappear from view, as if falling into a hole perfectly dark, then the body appears to us black, and only becomes visible because it is contiguous to surfaces which reflect or transmit light. Among black bodies we know none which is perfectly so, and this is because they reflect a little white light by which they affect our sight. What proves this reflection of white light is that the blackest surfaces if polished reflect the images of illuminated objects placed before them."

VARIATION OF THE INTENSITY OF CURRENTS TRANSMITTED THROUGH IMPERFECT CONTACTS ACCORDING TO THE PRESSURE EXERTED UPON THEM.—Th. du Moncel.—With reference to the wonderful results obtained by Edison and Hughes by the use of currents of an intensity varying with the pressure exercised upon the contact-pieces of a circuit-joiner, the author calls the attention of the Academy to the researches which he has undertaken at different epochs on this kind of effects. Thus, in 1872, when commencing his great investigations on the conductive power of imperfect conductors, he was led to measure the resistance of charcoal dust and of metal filings, which he found to vary according to the more or less brilliant state of their surfaces and the manner in which they are aggregated around the electrodes.

THE PHONEIDOSCOPE.

Various suggestions have from time to time been made as to the manner in which the iron disk in the telephone vibrates when it receives impressions of sound, and especially that of the human voice. We are certain that the metal plates do take up these sounds in their completeness, both with respect to pitch, quality and relative intensity, for without the last two we could have no articulate, and without the first no musical, transmissions. The subject, however, has not yet been fully worked out, nor has any really satisfactory explanation of the phenomena in question been given. With a view to elucidating the matter, and affording a means of making these intricate plate vibrations apparent to the eye, Mr. Sedley Taylor devised his phoneidoscope. In this instrument a film of soap bubble solution, when in a state of tenuity sufficient to show interference colors by reflected light, is brought under the influence of the aërial disturbance resulting from vocal or other sounds. Definite figures then form themselves in the film corresponding to each different sound as it is presented. Such figures consist of colored bands and circles, symmetrically placed, and varying in arrangement according to the shape and size of the orifice used, but constant in form for a sound of given pitch and quality with the same orifice.



The instrument is shown in the sketch. A brass cylinder, B, has inserted at its lower end the tube, C, and carries at its upper end the circular and horizontal plate, A, which is annular, its perforation corresponding to the diameter of B. C communicates with the conical mouthpiece, E, by means of the India rubber tube, D. The whole for convenience is mounted on a stand, F. The purpose of A is to support disks of sheet brass, through which apertures of various shapes and sizes have been cut. When the phoneidoscope is in use these apertures are made to contain the film of soap bubble solution to be experimented upon. We thus have a plate consisting of an extremely delicate medium, and which, by reason of the fact that the colors reflected from its surface are an indication of its degree of tenuity at any point, affords us a help to realize the state into which it, or, indeed, any plate, is brought under the influence of sonorous vibrations. The figures are infinite in variety, and the results as beautiful as their origin is simple. So sensitive are these films that they readily distinguish sounds of the same pitch but of different timbre. Thus, if the vowel sounds of the human voice be sung into the instrument, each one will be represented by its own distinct color figure, although they may all have been intoned on the same note.—*English Mechanic.*

MORDANT FOR TURKEY-REDS.

By Dr. A. Muller-Jacobs.

The invention relates to the preparation of a peculiar oil, named Turkey-red mordant, for the production of Turkey-red in dyeing, and printing upon yarns and tissues of all kinds, with madder, and all preparations of madder, including artificial alizarine, purpurine, and all analogous coloring matters. A single passage through this oil along with a proper addition to the color-baths supersedes in printing and dyeing the usual and oft-repeated white baths, and yields a color not inferior to ordinary Turkey-red in beauty and fixity, and if applied to common madder colors imparts to them a peculiar luster. The Turkey-red oil is a mixture of the sulpho-ricinoleate of soda and the sulpho-pyroterebate of soda. The preparation is conducted as follows:

1. Sulpho-ricinoleate of soda.—Castor oil, ordinary or purified, is mixed with 20 per cent. of its weight of sulphuric acid, at 66° B., the acid being caused to flow into the oil in a thin stream. This operation is best conducted in iron vessels, lined with lead, on the bottom of which lie leaden tubes, in which ice-cold water is allowed to circulate, in order to prevent a rise of temperature in the sirupy mixture. After standing for two or three hours the mass is diluted with water at pleasure, and neutralized with a lukewarm solution of soda—2·8 kilos. soda crystals to every kilo. of acid employed. The alkaline liquid is added slowly and with constant stirring. The mixture is then allowed to stand over night. The next morning the sulpho-ricinoleate of soda is found separated, and after the removal of the water is ready for future use. If pure oil is employed, the quantity of sulphuric acid may be reduced to 15 per cent. If impure castor oil is taken, 20 per cent. will be needed, and in some cases even more.

By sulpho-ricinoleic acid the inventor understands an acid of the formula—

$$C_{36}H_{33}O_4HO.SO_3 + HO.SO_3.$$

i.e., ricinoleic acid, conjugated with sulphuric acid, resembling sulpho-glyceric acid, or Fremy's sulpholeic acid, which latter is formed on treating olive oil with concentrated sulphuric acid in the cold. The acid itself, and its alkaline and ammoniacal salts, are readily soluble in water, but on prolonged standing or on boiling are decomposed, taking up water, and forming a fatty acid, closely connected with oleic acid (metaoleic or hydroleic acid), and sulphuric acid or sulphates. The inventor has examined the mixture of castor oil and sulphuric acid. The analytic results show that a compound is formed resembling sulpholeic acid. The aqueous solutions are precipitated by metallic salts, and on the decomposition of the latter by heat, *e.g.*, the lead precipitate, there remains a quantity of lead sulphate tolerably in harmony with theory. The glycerine simultaneously liberated by the treatment of the oil forms sulpho-glyceric acid, and forms an aqueous solution with excess of sulphuric acid, from which the sulpho-ricinoleic acid and its salts are readily separated, being insoluble therein.

The compound obtained is naturally not of absolute purity. While castor oil soaps have absolutely no power as mordants, the action of this substance as a mordant is readily intelligible. On mere exposure to the air there are formed in textile fibers steeped in this mordant salts of sulphuric acid, along with those of ricinoleic acids, analogous to metaoleic and hydroleic acids—which are also mordants—insoluble in alcohol, and soluble only in ether. They are scarcely attacked by strong alkalies. The same compound can be formed from olive oil by slow oxidation. No acid is necessary, in order to separate the alkali from a sulpho-ricinoleate. The substance is decomposed spontaneously, and the sulphate of soda washed out.

2. Pyroterebate of soda is prepared by boiling, in enameled iron vessels, 250 parts of rosin, which is powdered and added in small portions. After the lapse of 1¼ hour the liquid is gradually concentrated, and the residue is heated for half an hour to 200°—250° in closed iron vessels. When cold the semi-fluid mass is treated with 20 to 30 per cent. of sulphuric acid at 656° B., and after two or three hours it is neutralized with soda, and the sulpho-pyroterebate of soda, which separates out of the solution of sulphate of soda, is reserved for use. To make up the mordant, equal volumes of the solutions of the sulpho-ricinoleate and of the sulpho-pyroterebate of soda are mixed, and used at once in the preparation of Turkey-red. Experiments with chemically pure products show that the best proportions are 6 to 7 parts of the sulpho-ricinoleate and 3 to 4 of the sulpho-pyroterebate. Instead of soda may be used potash, caustic alkalies, ammonia, alkaline earths, or their carbonates. Instead of the above-specified mixture, the inventor claims the use of a mixture of the sulpho-ricinoleate of soda or ammonia, with the mixture of sulpholeate and sulph-margarate of soda or ammonia, formed by treating olive oil with sulphuric acid, and neutralizing with ammonia.

A FLAX AND JUTE CARD, AND HOW IT IS MADE.

Such of our readers who follow our articles on the manufacture of the common objects in a mill will have before now remarked that to make some of the most simple of them, several processes and very intricate machines are required. This is especially the case for the description of card clothing we purpose commenting upon in this article.

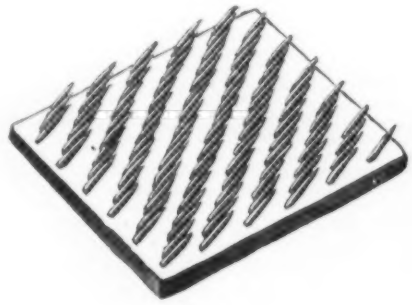


Fig. 1.

The broad distinction between it and other kinds of clothing, say that for cotton or wool, consists in the wires being considerably larger, sharply pointed, and more widely spaced. Our illustrations, Figs. 1 and 2, will give an idea of the appearance of this clothing, which is made in any required length, sometimes hundreds of feet, for the purpose of wrapping spirally around the cylinders and rollers of the carding engine. Our sketches therefore show only short lengths of card fillets (as they are called), the illustrations being about three-fourths of the actual size.

We defer for a while saying anything about card filleting for cotton and wool, the backing for which, that is, the material in which the wires are set, is made in almost endless variety, whilst that of the card, now the subject of our notice, with a few exceptions, consists of leather. When the use of this material, for the sake of cheapness, is departed from, its substitutes cannot always be recommended. The

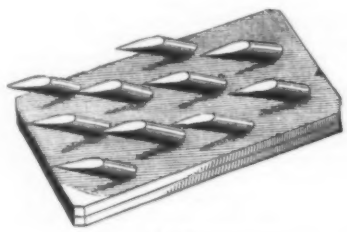


Fig. 2.

hides, when they arrive from the tanners, are in a condition utterly unfit for immediate use; they have first to be steeped, scoured, and to undergo the other operations of the currying process, the product being leather. The sheets are now cut by a special tool, forced along by hand, into strips sufficient in width to make two card fillets. Every time a strip is cut the workman tries its thickness in several places with a Birmingham wire gauge, the number corresponding to the thinnest part being marked on the strip. The card backing must be perfectly uniform in its thickness, otherwise some teeth would be higher than others, and uneven carding would result; therefore every piece of leather has to be shaved down to its thinnest part, which is all it stands good for. The pieces of equal thickness go together to make one fillet, and a rigorous inspection has now to be made for the flaws and imperfections the leather may contain, which flaws are only too frequently present on account of careless currying and bad butchering; in fact, an unskilled butcher can, without knowing it, depreciate the value of a hide by the sum of 10s., and cause those who have subsequently to use the leather made from it a great amount of trouble and loss. Too much care cannot be taken in searching for weak places in the strips, and when found to remorselessly cut them out, even though the result be the loss of several inches of good leather, for should the clothing break when the carding engine is at work, the state of affairs for confusion and damage would be fairly on a par with "a bull in a china shop."

We have now pieces of leather of all lengths, from one to four feet, which have to be joined into one continuous fillet. The ends of every strip are thinned down, or "spliced," as it is termed, so that when the spliced ends are brought together and cemented with isinglass the whole fillet is of one even thickness, which, as we have already pointed out, it is important to attain. A sizing preparation is next applied to the leather, and the fillets hung up to dry, the object of this application being to give it greater stiffness and the better to support the teeth. If the teeth are to be set in by hand, the filleting is punched with holes properly spaced for their reception. The edges are also made truly parallel with the same machine.

We come now to the preparation of the teeth. The shape and size of these vary greatly. In Figs. 3, 4, and 5 we show the prevailing typical forms. Fig. 4 represents the variety known as needle points. In these, as we leave the extreme points, the acting parts of the teeth get more blunt as it were; it was therefore considered an improvement

Fig. 3. Fig. 4 Fig. 5.

to make them of flat wire, as shown in Fig. 5, but here the objection is the small amount of stiffness the teeth have sideways. To remedy this the wire is made triangular in section; in fact, with a thick back and with almost a knife edge in front. This form is shown in Fig. 3, nearly actual size, and is used for opening cotton cop bottoms, and also in mungo machines. Other forms of teeth are in use, the difference consisting in the section of the wires, some being oval, others with rounded backs and edges in front, and some of a double convex section.

We will not attempt to describe the machines employed for setting the teeth, for without several pages of engravings and columns of letterpress it would be utterly futile to do so, even supposing a card maker would supply us with the necessary particulars with a view to their publication. Each maker, it may be said, has machines of his own contriving, and as the trade is an exclusive one, as a rule they are jealously guarded from inquisitive strangers. We, however, had *carte blanche* to inspect the card making establishment of Messrs. Thomas Fleming & Son, West Grove Mill, Halifax, and full permission to describe what we saw there. When the cards are to have needle-pointed teeth, the wire has to be prepared in one machine and set to the fillets by another. The wire (of iron) is fed from its coil into the first machine, which shears off lengths sufficient to make a pair of teeth. (See Fig. 4.) The same machine also makes the points and burnishes them, so that when the lengths are ejected into a receptacle they are neatly pointed at each extremity. They are now ready for setting in the fillets, and for this purpose are placed in a box situated on the top of the machine used for that purpose. The box has a width equal to the lengths of the pins, and is made with an inclined bottom, at the lower end of which is a small slit through which the pins can just emerge on to a small incline. A moving magnet takes charge of the first pin, the others being retained on the incline during the time it is being bent and set. The magnet conveys the wires to a pair of jaws which grip it at its middle, and after other movements have bent its ends, forces these ends into the leather, holes for their reception having already been made from the other side

Fig. 6.

of the fillet. These two teeth, so set, at this moment project at right angles from the filleting, but by means of a lever and another movement in the machine, they are bent into the proper inclined form. The fillet now moves and exposes a fresh place for the insertion of two more teeth, and others in succession. The wires are sometimes inserted by hand, particularly on the Continent, in which case an addition to the machine which points the wires also bends them into the form shown in Fig. 4.

When triangular or flat wire is used for teeth the preliminary pointing required for round wire is dispensed with, the points here being made when the lengths for two teeth are sheared off. This is done by a peculiar shaped punch which cuts out a wedge-shaped blank. (See Fig. 6.) In this case this pointing is done in the machine which sets the teeth, their construction being therefore different to those for setting needle points.

The teeth being set, the fillets are cut up their center lines, thus making two each of half the original width, and their edges are also pared so as to be exactly parallel with each other. The fillets have next to be stretched. This is accomplished by coiling it on a large cylinder, and inserting a piece of wood under one of its ends, then revolving the cylinder until it passes along under the spiral to the other end, at the same time pulling the leather as far as its elasticity will allow from the surface of the drum. The stretch thus taken out of it, the end last reached is secured to the cylinder, and the teeth of the fillet subjected to close scrutiny, sometimes with a magnifying glass, in order that imperfections, such as bent points, and points left out, may

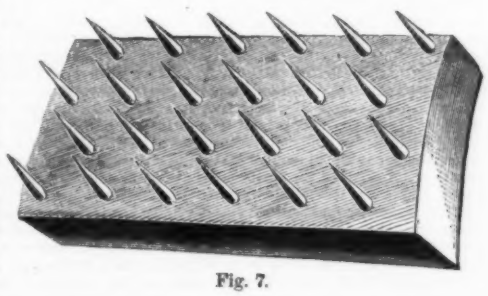


Fig. 7.

be rectified. With machine-setting the faults are extremely few, and consist chiefly of a pair of teeth left out here and there. These, however, are of so rare occurrence as scarcely to merit notice; a fillet may be completely set with not a single defect in it. After coiling up, protecting the points with thick paper, it is ready for the market; when for export it is further packed in waterproof cases. As a curious instance of

what the low wages on the Continent can accomplish, we are informed by Mr. Fleming that although he may supply the prepared teeth, they can in some cases be set abroad cheaper by hand than by his machinery he can supply the completed article. The quality of the work, however, will be vastly inferior.

Cards, such as we have described, are known in the trade by numbers, the number of a card being that of the gauge of the wire in it. This varies from eight up to twenty-two for needle points.

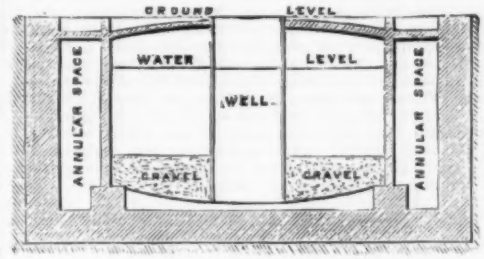
It should be mentioned that a practice has lately arisen of facing the card, or rather the leather, with metal. We noticed some brass and zinc faced filleting in process of manufacture at the West Grove Mill, in the same machines as are employed for the ordinary kind. The advantage of metal facing is that it keeps all moisture from the leather, is better support for the teeth, strengthens the fillet, and also gives a better and smoother face for the fiber to work against in carding. We saw samples also of card clothing in wood (if our readers will pardon the seeming contradiction in terms), and of which we illustrate a portion in Fig. 7 Properly speaking it is lagging, being placed circumferentially, but with its length across the width of the cylinder. The curvature necessary for being thus fitted will be noticed in the sketch. Steel points are used, set in well seasoned beechwood.

In conclusion it will not be out of place for us to remark that Messrs. Fleming & Son, to whom we are indebted for these particulars, besides carrying on a large trade in card clothing, also do a considerable business in belting, for which a portion of their establishment is well laid out, being fitted with the latest appliances. In particular we noticed a wire sewing machine for belts up to 54 inches, and as a sample of good workmanship the fine 30-inch belt made by the firm for the Halifax Flour Society deserves commendation. This belt is to be one of a pair; at present it transmits 320 H.P. at 3,800 feet per minute. It is of course made double; the outside layers are of the whole width of belt; the inside layers are made three in the width, each of ten inches, the whole being wire-sewn, or, more properly, riveted together.—*Textile Manufacturer.*

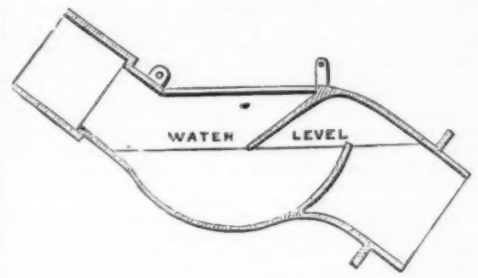
VENEZUELAN GOLD MINES.—At the close of the eight-hour day's work the finger and toe nails of all the men are *scraped*, their hands and arms are very thoroughly washed, and even their *ears* are examined, to prevent them from carrying away any part of the precious dust and ore.

FILTERING CISTERN.

AMONG the exhibits at the Paris Exhibition is a filtering cistern or well by Y. Moscucci, of Poste Restante, Paris.



The construction will be readily understood by reference to the engraving. It is intended for filtering rain water for drinking purposes, for country houses, small towns, etc.



NEW SEWER TRAP.

OUR illustration shows an improved trap by M. Durat, as shown at the Paris Exhibition.

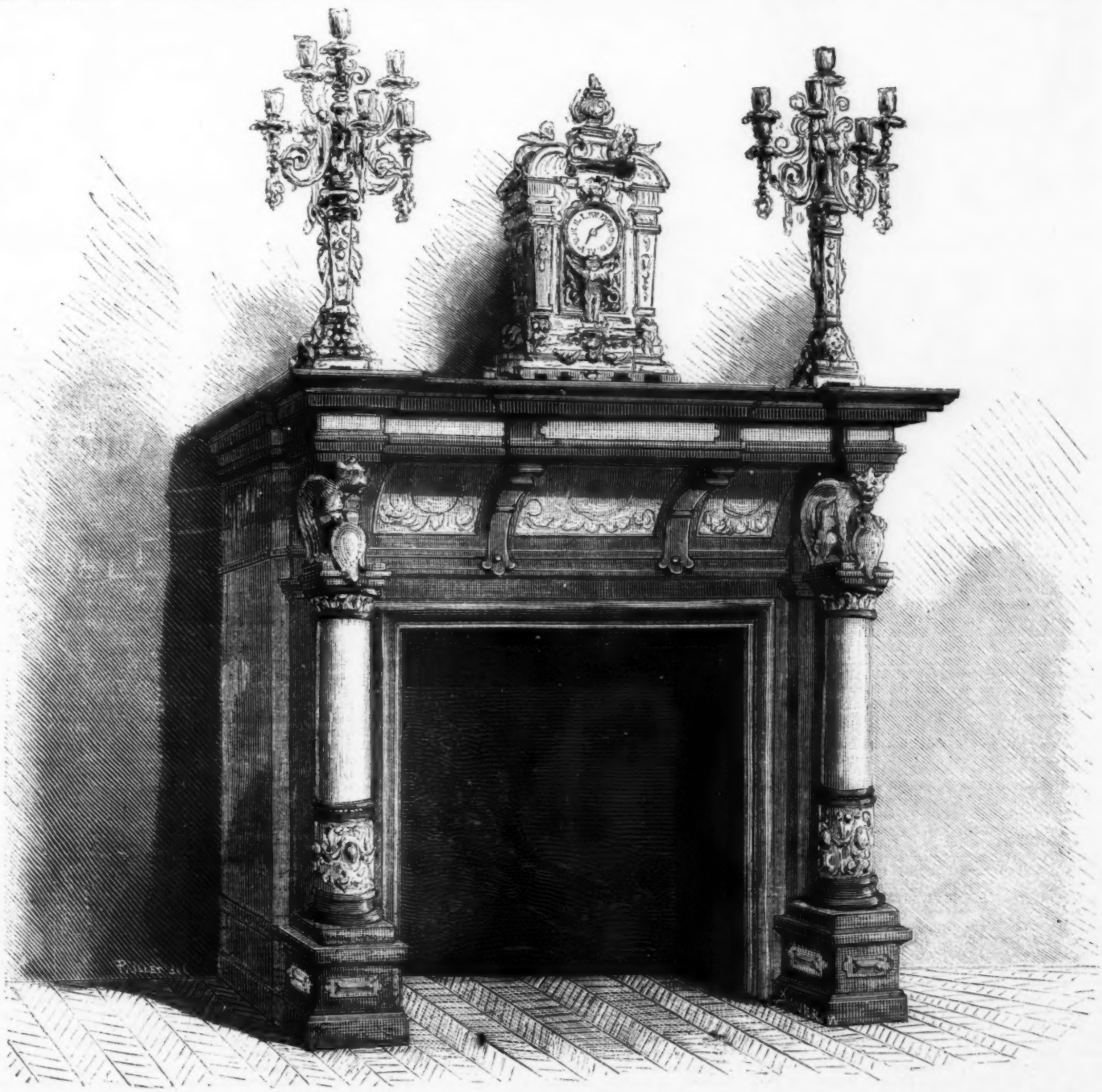
FANCY AND ORNAMENTAL GOODS AT THE EXHIBITION.

THE Belgian Bronze Company make a display befitting the country which is, in proportion to its extent, one of the richest in minerals in the world. The Belgian mineral industry is described in a special catalogue of great value, printed at Liege, by Vaillant-Carmanne. This volume gives statistical details of the collieries, mines, and metal works of the Province of Liége, and the coal companies of Charleroi, Namur, of the Central Basin, and of Mons. The Bronze Company's exhibition, of which our engraving is an example, belongs to the lighter and more ornamental part of metal work, in which France (as well as England and Belgium) ranks among producing countries. The tasteful union of metal and other materials gives value to these productions, which, like the works of branches of art more generally acknowledged and admired as such, depend for their success upon the form, beauty, and originality of the completed whole, rather than on any intrinsic preciousness of the parts. —*Illustrated Paris Exhibition.*

FOOD PRODUCTS AT THE PARIS EXHIBITION.

THE French Food Collection, as would be naturally anticipated from the excellence of the soil and climate of France, presents, says the *Lancet*, many great and important peculiarities. Thus the extensive cultivation of the vine leads to the production of a vast number of different wines, and especially of red wines, which are the very best that the world produces. The same widespread cultivation of the vine also renders spirit or alcohol very abundant, including *eau-de-vie*, or brandy, which is produced in France, also of a quality not to be equaled elsewhere. This abundance of alcohol, again, leads to the fabrication of a great variety of stimulants, condiments, and liqueurs, many of which will be noticed hereafter, and in the preparation of which much skill and ingenuity is expended. Again, this abundance and cheapness of spirit allow of the preservation in it of a great variety of fruits, which, on account of the mildness of the climate, are likewise abundantly produced.

Then, for the same reasons of soil and climate, France is a great oil-producing country. Everywhere in the southern portion of the kingdom the olive tree is to be seen bearing its myriads of small, and, when ripe, plum-like, somewhat insignificant-looking berries, but which, when pressed, yield the bland, delicate, and valuable olive oil. In this,



THE PARIS EXHIBITION.—CHIMNEY-PIECE AND ORNAMENTS BY THE BELGIAN BRONZE COMPANY. STYLE, FLEMISH RENAISSANCE.

again, they are provided with the most suitable medium for the preservation of the fish, especially sardines, which abound on the coasts of Brittany, and the preserving of which alone constitutes a vast industry.

Furthermore, France is a great sugar-producing country. This also gives her facilities for the manufacture of preserves and the preservation of fruits generally. Again, in this sugar she has an additional source for the manufacture of alcohol.

In truth, it may be said of France that it is a land abounding in corn, wine, and oil, and that in it every man may sit under the shadow of his own vine and fig tree.

Fish, fruit, and vegetables thus abounding have led to the study and invention of various means for the preservation of vast quantities of these several kinds of food. So abundant are they, and so excellent are the means taken to preserve them, that they are largely exported to almost every country in the world, and constitute a great source of national prosperity and wealth. Thus France supplies to the world nearly all its crystallized fruits, as well as those preserved in spirit; its peas and beans, and other green vegetables; its olives, capers, mushrooms, and truffles.

From these few and brief remarks it will be apparent that the French food products exhibited in the International Exhibition, rightly understood and interpreted, must possess not only for France, but for the whole world, a high degree of interest.

It is not our intention, however, to notice all the articles exhibited, or to describe those of each exhibitor. The space at our command compels us to treat the subject in a briefer manner, and what we propose to do is to notice chiefly those exhibits which possess the greatest novelty, interest, and importance, and which we ourselves have had the opportunity of examining. We fear this course may occasion disappointment to some exhibitors, but there is really no help for it, for were we to enter as fully as might be done into the subject, we should, instead of occupying a few pages of this journal, fill a whole volume. Thus, for want of space, and other reasons, we refrain from giving any account of the various wines exhibited. These number many hundred different kinds and varieties, and to treat of this subject at all as it deserves would occupy very many pages of this journal. For similar reasons we omit to mention the names of the exhibitors of brandies and other spirits, as also of olive oil, of which alone there are not less than fifty exhibitors. Then, again, a great many firms exhibit numerous samples of wheat and flour. These, also, are out of the range of this report.

Lastly, we should not forget to notice the great care and taste displayed in the putting up of the majority of the French preserved provisions, and which are truly remarkable; every detail is carefully studied and carried out: the shape and manufacture of the inclosing bottles or other vessels, the form, coloring and quality of the labels, and even the corking and securing the bottles. There is in all these particulars a refinement rarely to be met with out of France.

The arrangement of the food-products adopted is a very simple and natural one: (1) cereals with their farinaceous derivatives; (2) bread and pastry; (3) oils, fats, cheese, milk, butter, and eggs; (4) meat, fish, vegetables, and fruit; (5) condiments, stimulants, sugars, and bonbons; (6) fermented beverages. This arrangement, in the main, we propose to follow, only we shall have but little to say under some of the above headings, including the cereals themselves, although rather more on their derivatives, the arrowroots and feculas.

Among the exhibitors of farinaceous products we noticed the following, and we had in many cases the opportunity of examining samples of their exhibits: Mons. R. Barlérin, of Tararc; Mons. N. J. Bloch, of Tomblaine; Mons. F. Boudier, of Paris; Messrs. Brun et Cie., of Lyons; Mons. A. Chapu, of Paris; Messrs. Chétard Fils et Chaumeix, of Clermont-Ferrand; Messrs. C. Delamarre et Fils, of Chelles; Messrs. Dolmaire et Toussaint, of St. Dié; Mons. Dutaut, of Paris; Messrs. Foussat, Durand, Darrieux, et Cie., of Bordeaux; Mons. P. Genet, of Nancy; Messrs. Givord et Hours, of Lyons; Mons. V. Jeanclaude, of Lunéville; Mons. F. Laporte, of Toulouse; Messrs. Leconte-Dupont, of Paris; Messrs. Maiche et Arnouilleau, of Foucauge; Mons. Marge, of Lyons; Messrs. Mathieu et Cie., of Villars; Mons. A. Mauprivez, of Paris; Mons. L. Morel, of Epinal; Mons. J. T. Moricelly Ainé, of Marseilles; Mons. A. Périmon, of Neuilly; Messrs. P. Pesier et Cie., of Valenciennes; Mons. Felix Potin, of Paris; Messrs. Roche et Fils, of Rochefort; and Société Anonyme "La Marseillaise," of Marseilles.

Mons. Barlérin has been good enough to afford us the opportunity of examining his "Farine Mexicaine." Judging from the statement made respecting it in Mons. Barlérin's prospectus, it must possess properties little short of the miraculous. "It is now a certain fact that those persons who have died of disease of the chest did not make use of the 'Farine Mexicaine,' for if they had they would now be still full of life, it being well ascertained by science that all diseases of the chest are curable by the 'Farine Mexicaine.'"

Among several other arrowroots and farinas, Mons. Chapu exhibits a "Tapioca de l'Etoile." This consists of Brazilian arrowroot, or the farina of the manihot. This is particularly well adapted, from its solubility, for thickening soups. The sample we examined possesses a beautiful white color. It is evidently very carefully prepared, in a form suitable for soup. Another of his exhibits is "Tapioka da Estrella." This is a very superior quality of Brazilian arrowroot.

Messrs. Chétard et Chaumeix, manufacturers of pâtés alimentaires, exhibit "Semoule Diastasée" and "Racahout d'Auvergne." These preparations are made from the wheat of Auvergne, which is stated to be particularly suitable for the manufacture of semoule, since they approach in character the hard wheats of Africa and Taganrog, and contain, like them, a larger proportion of nitrogenous matter and gluten than the soft wheats. The semoule is in a state of coarse powder, and is of a brown color, due to its having been subjected to the action of heat, or diastased. The racahout is in the form of a fine flour, of a light brown color, also due to careful torrefaction. Both these articles, from their nutritious properties, and from the partial cooking which they have undergone, whereby part of the starch has become converted into diastase, are well suited for the alimentation of infants and children.

Messrs. Dolmaire & Toussaint, who are also fabricants of alimentary preparations, exhibit an article which they call "Manioca." This is in a coarse powder, and also browned from the action of heat. It is employed for thickening soups and sauces, for making gruel, in roasting meat, and frying fish, for all of which purposes it is well adapted by its composition and mode of preparation.

Mons. Dutaut exhibits a "Fécule Dutaut," or "Nursling's Food." It is taken in the form of pap, mixed with water, broth, or milk, according to the age of the child. The maker produces a considerable number of testimonials from medical men, certifying to the value of his food.

Mons. A. Mauprivez exhibits "Tapioca naturel." This is the product of the *Jatropha manihot*. As imported it is in the rough state, and in large masses, which contain impurities, and are of a bad color. The tapioca has, therefore, to be subjected to treatment whereby the foreign matters are removed and the masses reduced to a convenient size for thickening soups, or for boiling with milk. Tapioca thus purified is one of the most useful and nutritious of the arrowroots.

Messrs. Moricelly exhibit samples of "Semoule" and "Semoulette." These are of very fine quality and superior manufacture, and are made from the hard wheats of Algeria, which, with those of Taganrog, are the best suited to this manufacture, as also that of Italian paste.

Mons. Roche, pharmacien, exhibits a "Farine Diastasée, intended especially for the nourishment of infants, and the composition of which he very candidly makes known. It consists of 830 parts of baked wheat flour, 100 of barley flour, 60 of sugar of milk, and 10 of bicarbonate of potash, with, in some cases, 20 parts of phosphate of lime. The barley flour is added to obviate any tendency to constipation which the wheat flour may produce, the potash is to correct acidity, and the phosphate of lime to supply that necessary constituent to the bones and growing tissues. The formula is certainly a good one, and the preparation carefully made. From its sweetness we judge that it contains some white sugar, and from its odor, also, a flavoring of vanilla.

Some of the makers of starch and feculas are also manufacturers of dextrine and gum; and others, again, of "Sirops massés," or consolidated sirups. Thus Messrs. Leroux, Louvet et Fils, of Rouen, manufacture, in addition to starch, both dextrine and gum.

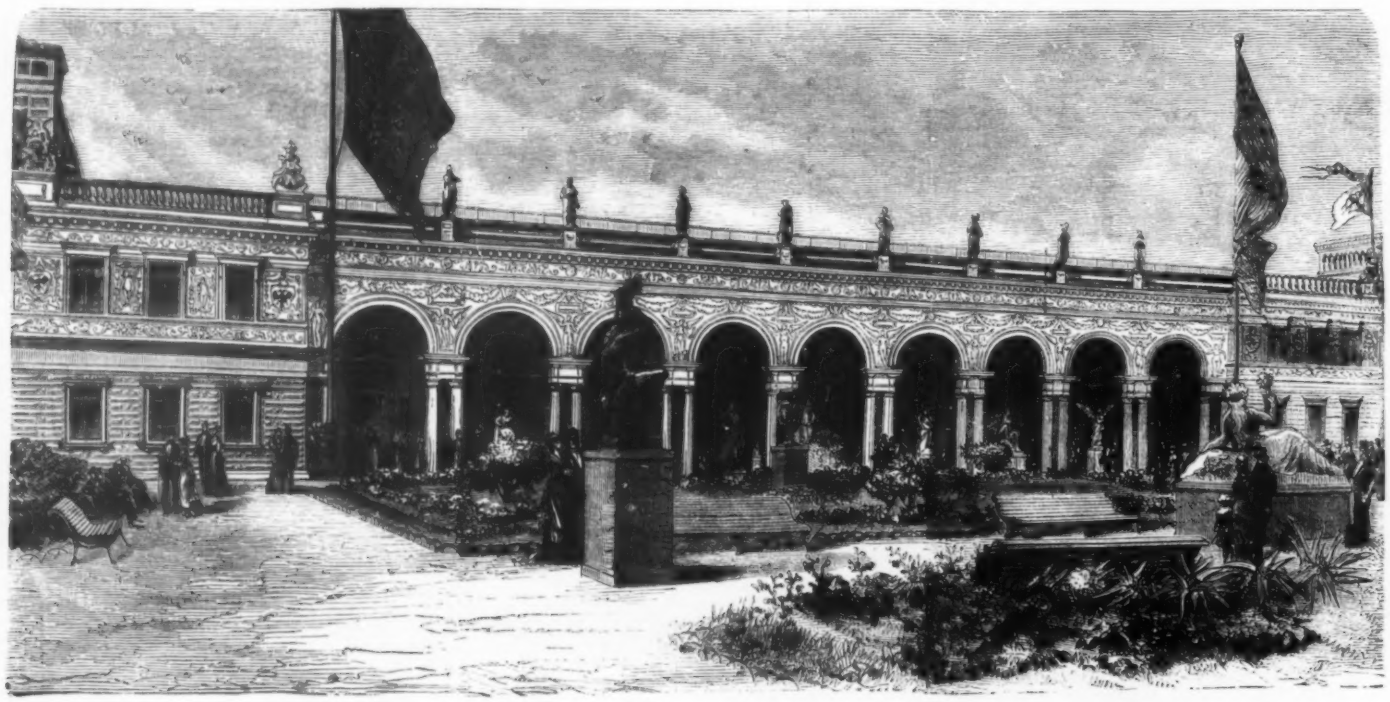
Messrs. Lefevre & Olivier, of Rueil, fabricants of glucose, very kindly invited us to visit their manufactory, an invitation of which we regret we were unable to avail ourselves.

Mons. V. Jeanclaude, of Lunéville, gave us the opportunity of examining a sample of their "Sirops Massés de Fécules." This was hard, white, dry, and sweet, and when burned it left only a trace of residue. It was evidently a sirup of very superior manufacture and quality. This article is now much used by brewers, taking the place, to a large extent, of malt, the term "malt beverages" having now become in many cases a misnomer. The law in England allows the use of sugar and several bitters, so that it is quite possible to make a very palatable beer which does not contain a particle of grain, malt, or hops.

A great many bakers exhibit "Gluten Bread;" in fact, the number who do so is really surprising, making one believe that diabetes must be a very common complaint in France. Mons. Bonnefoy, of Paris, exhibits "Pain de Gluten" in two or three convenient forms. The loaves are small, very nicely made, and resemble outwardly, in form, color, and even weight, ordinary bread. Dr. Ruelle certifies to the superior quality of the gluten from which they are prepared, and to the care and pains bestowed by Mons. Bonnefoy on the manufacture of this description of bread. The loaves are sent daily through the post to all parts of France, and even to England.

While France has been long celebrated for its bread and pastry, it has until recently been much behindhand in the manufacture of biscuits, owing, doubtless, to the fact that hitherto they have not been much consumed, and, consequently, there has not been any great demand for them. Now, however, as the taste for biscuits is increasing, and English kinds make their way in considerable quantities into France, more attention is given to their manufacture. A biscuit may be described as a concentrated form of food, exceeding in nutritive value in some cases even bread itself, owing to the small quantity of moisture contained in them, sweeter and pleasanter to the palate than ordinary bread, but far less rich, and consequently less indigestible, than most descriptions of pastry. Their increased consumption, therefore, from a health point of view, is to be desired.

Among the many manufacturers who are exhibitors of biscuits are the following: Mons. E. Barbot, Rochelle; Mons. W. Dennis (the American Company), Paris; Mons. P. Deschamps, Paris; Mons. P. Gondol, Paris; Mons. Deshages, late Letourneur, Havre; Messrs. Olibet Fils, Talence; Messrs. J. Sigaut, Paris; Messrs. Thebaud et Hubert, Nantes; Messrs. Vendroux, Clement, et Cie. (Société Anglo-Française), Calais.



THE PARIS EXHIBITION.—FACADE OF THE AUSTRIAN SECTION, AVENUE OF NATIONS.

Messrs. Dennis et Cie. manufacture a great variety of biscuits, including "Boston crackers," a biscuit of American celebrity. They were good enough to submit to us a variety of their products, which were of excellent quality, and carefully manufactured. They showed us also a sample of a biscuit prepared in large quantities for the Russian army, consisting mainly of rye and pollard. They were excessively hard, and would require much soaking before they could be eaten, and supposing them to be digested, it is still difficult to understand how they could possibly keep body and soul together.

Mons. Deschamps exhibits a biscuit of pleasant crispness and very delicate flavor, which he names the "Biscuit Viennois," as also "Croquettes Hongroises," likewise of very agreeable taste. The flavor and manufacture of these biscuits seem to be unique, for among the very many different kinds we have examined we have not met with any to resemble them. Messrs. Deshages make a "biscuit à potage" and sea biscuits. The specialty of the well-known house of Messrs. Béhu et Sigaut is the manufacture of different kinds of gingerbread. This description of cake has of late years gone somewhat out of fashion in England, although in our annual fairs the trade in it still flourishes, and the ginger-nut is, to our fancy, one of the pleasantest forms which gingerbread is made to assume. In France and Germany it would appear that gingerbread still retains its position; of this fact the old-fashioned house of Messrs. Sigaut, employing as it does over a hundred workpeople, is a sufficient witness. Before we had the opportunity of examining the various productions of this firm, we had no idea of the perfection to which the manufacture of gingerbread could be brought, or the extent of its consumption. Quoting from *Le Panthéon de l'Industrie*, we find the following, given as the quantities of the principal materials used in their manu-

factory in the year 1866: "120,000 kilogrammes of wheat flour, 180,000 kilogrammes of rye, 400,000 kilogrammes of honey and sugar, 12,000 kilogrammes of candied fruits, 15,000 kilogrammes of almonds, and 500,000 eggs." Then, as regards machinery, there is a mechanical saw to cut the gingerbread, a machine to grind the vanilla, a machine for cutting up the candied fruits, a movable machine for cutting pastry, a machine to separate the yelks from the whites of eggs, a machine for skinning almonds, a machine for moulding the gingerbread; all these being worked by steam power. Among the samples of gingerbread examined by us were: "Pain d'épice au Seigle" (that is to say, with rye), "Pavé de l'Exposition," "Carrés Garnis de Fruits," "Carré Sigaut à la gelée de fruits glacée au Rhum," "Nonnettes glacées à la vanille" (in the form of small, thick, round cakes), and "Nonnettes de l'Exposition glacées aux fruits." The whole of these are put up in a style of great elegance and richness, some of the labels being perfect works of art. The Messrs. Sigaut manufacture other cakes and sweetmeats, and one we were especially curious to see, and to which they have given the singular name of "Biscuits Parlants." On examining these, we found that they owed their name to the fact that each biscuit had bound round it a piece of paper bearing a motto.

The Société Anglo-Française (Messrs. Vendroux, Clement, Verlingue, et Cie.) have a large biscuit manufactory at Calais, and make not only French biscuits, but a great variety prepared in imitation and bearing the names of the best known kinds of English biscuits. The number of these varieties, differing only in very slight particulars, has become really embarrassing, and it is impossible to do more than single out for notice a very few. That there should be so many different sorts of biscuits depends on the various tastes of consumers, each, we suppose, having his favorite kind. Among the English-made biscuits which more particularly attracted our attention, rather from their novelty and appearance than anything else, were the "Balmoral,' in imitation of rural objects; the "Croquets," containing almonds; the "Osborne fourre," which consists of a plain biscuit covered on one side with a thin coating of sirup or jam; lastly, the "Star" biscuit, so called from having a white or pink star made from a most pleasantly flavored sugar in the center of each biscuit, the sugar imparting a bright and pleasing appearance to the biscuits. The "Vanilla drop" is also a very nice fancy biscuit. Among the French biscuits we noticed the "Algérien," which are flavored and ornamented in the center with pieces of preserved fruits; the "France," a plain, useful, and delicately-made biscuit; the "Pistache," resembling "Croquets," but, instead of almond, containing pieces of pistachio nut; lastly, "Rocailles," a rough and rocky biscuit, into the flavoring of which almond largely enters. Many of the biscuits manufactured by this firm are very nice, and obviously prepared with considerable care.

A highly important industry consists in the preparation of olive oil, the tree which furnishes this oil growing principally in Languedoc Provence, and in Corsica. The olive tree, so far as relates to the color and shape of its leaves, resembles the willow, the upper surface of the leaves being dark green, while the under surface is of a light silvery-gray color. It blossoms in the early spring; the flowers, which are axillary and grow in clusters, being small, delicate, and of a yellowish-white color. The unripe fruit, as every one knows, is of a pale green, but when ripe it becomes dark and of a reddish-blue or plum color. The olives are usually gathered in the months of November and December, but the time is often extended much beyond this; yet it is desirable that the berries should not be too ripe. Those which are hand-picked are the best, being free from bruises, but on account of the large size of many of the trees this is frequently impracticable, and then the berries are obtained by shaking and beating the branches, the olives falling on to cloths spread on the ground to receive them. This method of gathering is alike injurious to the berries and trees. In order to obtain the oil, the olives are subjected to trituration by millstones. The thick pulp thus obtained is placed in bags and submitted to gentle pressure. The oil thereby expressed has obtained the name of 'virgin oil," and is of the finest quality. The contents of the bags, after being treated with boiling water, are again pressed, when a second quantity of oil is obtained of a coarser quality. The pulp is then once more immersed in boiling water, subjected to further trituration and renewed pressure, when an additional quantity of oil is obtained, used generally for greasing purposes. Lastly, the cake which remains is again triturated, and, after treatment with acids, is submitted to a final very strong pressure, an oil being obtained which is used in the fabrication of soap. The residuum is employed either as manure or for fuel. The exhibitors of olive oil are very numerous, and it would serve no useful purpose merely to enumerate them; but the oils which have led us to make the preceding remarks are those of Messrs. Bessede Fils, of Marseilles.

The principal part of the vinegar manufactured in France is not made, as it is with us, of malt and grain, beer, or cider, but, as one would naturally suppose from the extent of the cultivation of the vine, from the grape, the quality of the vinegar improving with that of the wine from which it is prepared. For reasons with which we are not well acquainted, the wine vinegars of Orleans have a great reputation, which is shared by those of Bordeaux. The vinegar is generally made from white, but may also be prepared from red wine. Wine vinegar is a very different and superior product to that from malt, it being stronger in acetic acid, more ethereal and aromatic, and containing also the bitartrate of potash of the grape. Among the makers of vinegar we noticed the following: Mons. Boudin, Mons. A. Bornibus, Paris; Messrs. J. Bréton, of Orleans; Mons. E. Cruchet, also of Orleans, whose house was founded in 1790; Mons. Dessaux; Messrs. Louit Frères, of Bordeaux; Mons. E. Moraux, of Cambrai; Messrs. Maille et Tandeau, of Paris; Messrs. Renaud et Duallé, of Bordeaux.

Messrs. Bréton exhibit samples of vinegar prepared both by the old or slow process and the quicker or Pasteur's process. By the latter the alcohol is converted into vinegar in about one-fifth of the time occupied by the old process; moreover, it is stated there is by it a considerable saving of material, while the results obtained are equally satisfactory. The active agent in the transformation of the alcohol into vinegar by Pasteur's process is a fungus, well known in England, where it has been employed on a small scale by householders under the name of the vinegar plant. Messrs. Bréton employ the new process, but, owing to circumstances, we have not had the opportunity of examining samples of their vinegars; from the information, however, which has been communicated to us, we do not doubt that they will bear comparison with those of the best manufacturers.

Of the vinegars exhibited by Mons. E. Cruchet we have examined three samples—one of ordinary wine vinegar, one ten years old, and the third flavored with tarragon. These vinegars were of good quality, pungent, aromatic, and pure.

We visited by invitation the old-established manufactory of Messrs. Maille & Tandeau, of Grenelle, Paris, and were there shown a variety of large vessels filled with vinegar—some aromatized, others flavored with a great variety of vegetable substances, including truffles, mushrooms, raspberries, etc. We were informed that their vinegar manufactory was at Orleans. We did not examine samples, but we can bear testimony to the fragrance and apparent excellence of the vinegars. They possessed strongly the odor of the different herbs with which they were impregnated.

Messrs. J. Renaud & Duallé, an old-established firm of Bordeaux, make specially a vinegar which they have denominated "Vinaigre de Bordelais," which they guarantee to be absolutely pure, and samples of which we have examined with very satisfactory results. We have also examined, with the like favorable results, samples of their aromatized and tarragon vinegars.

To some vinegars various aromatic substances are added, with a view, as is stated, to produce what is termed aromatized vinegar (vinaigre aromatisé); in other cases certain vegetables are immersed in the vinegars until they acquire their respective flavors—as, for instance, tarragon, which is so much used in France.

As might be anticipated, the exhibitors of "Conserves Alimentaires" are exceedingly numerous, since the number of articles preserved is so very great. They include different kinds of meat, especially whole fowls and game, pâtés de foies gras, cockscombs, various descriptions of fish, as lobsters and crayfish, and particularly anchovies and sardines; while among vegetable substances may be mentioned particularly various descriptions of dried vegetables; vegetables preserved in liquids; endless peas, beans, mushrooms, truffles, and capers; fruits dried, crystallized, and preserved in spirit, including olives, chestnuts, plums, and a great variety of other fruits.

It would be impossible in the compass of this report to give any general description of the various products exhibited in the cases under the headings, "Substances Alimentaires" and Conserves Alimentaires." All we can do is to notice briefly a few of the above-named products. Among the exhibitors whom we particularly noticed may be mentioned the following: Mons. Beauhaire, of Montoire; Mons. A. Bornibus, of Paris; Messrs. Brard et Cocary, of Lorient; Mons. Biadot, Paris; Mons. C. Chevalier, Puteaux; Mons. P. Flen, Mons. Fourcade, Nantes; Messrs. Lermat, Robert, et Cie., Bordeaux; Messrs. L. Levesque, Nantes; Messrs. Louit Freres, Bordeaux; Messrs. Maille et Tandeau, Paris; Messrs. Pellier Freres, Mans; Mons. L. Reynaud, Chambéry; Messrs. Rödel et Fils, Bordeaux; Mons. J. M. Pommery, of Meaux; Messrs. Phillipe et Ganaud, Nantes; and Messrs. A. Salles, Paris. Messrs. Brard & Cocary exhibited preserved vegetables, especially peas and beans. Of these we are not able to say anything, as we did not examine samples, which we should have been glad to have done, not only in this, but also in some other cases, in order to satisfy ourselves of the absence of copper. The use of copper to color vegetables in France is strictly prohibited; nevertheless, a few years ago, the preserved peas and beans imported into this country from France were nearly always colored with this metal; and, even at the present time, it is no uncommon circumstance to meet with samples which are thus colored. This remark leads us to notice the invention of another exhibitor—Mons. Biardot, of Paris. This gentleman has succeeded in devising a process whereby he is enabled to fix the natural green color of almost all vegetables, and this in a very unobjectionable manner, and without the aid of a particle of copper or any injurious substance. Mons. Biardot describes the process as very successful, and, if it be also permanent in its action, then we consider that the inventor will have accomplished a very useful object. The preserved peas, beans, and pickles now sold are of a dull-yellowish or olive-green color—an appearance which may be safely accepted as proving the absence of copper; but still they are not so sightly as are the same vegetables with their natural color, and it will surely be a gain if their green and fresh appearance can be preserved in a harmless manner.

Mons. M. E. Fourcade, of Paris, exhibits a compressed meat, but we have not been able to examine any samples.

The house of Messrs. Louit Freres dates back as far as 1825, and it possesses three manufactories. At the one, "Turenne," fruits and vegetables preserved in vinegar, and sardines and anchovies are prepared; at another, "Bouscat," vinegars and mustards are made; and at the third, "St. Sernin," chocolate and pâtés for soups. We have examined a variety of the articles exhibited by this firm, including several descriptions of pickles. We would observe, in the first place, that nearly all French pickles are prepared with wine-vinegar. This at once gives them, as must be allowed, a superior character to English pickles put up in malt-vinegar; wine-vinegar being so much lighter, more fragrant and aromatic. Too frequently, however, the vinegar so employed is aromatized or flavored—very often with tarragon, the taste and smell of which is imparted to all the vegetables contained in the pickles; the individual tastes of these being altered and masked thereby. The pickles of Messrs. Louit Freres which we have examined include mixed pickles, onions, gherkins, and "blé de Turquie"—a small description of the tender and unripe pods of maize or Indian corn.

The mixed pickles are most tastefully arranged in the bottles, and include one or two vegetables, and even fruits, not used by us, as celery, carrot, maize, truffles, and even cherries and gooseberries. With the exception of the carrot these all form pleasant additions, and to the carrot there would be no objection were some means taken to soften it, and to remove its rawness and hardness. The corinchons or gherkins are the smallest and youngest possible, and absolutely free from copper. The onions are equally small and delicate, white and semi-transparent. The younger pods of the blé de Turquie or Indian corn, so neatly arranged in the bottles, present an elegant appearance, and form a tender and very agreeable pickle. The sardines and anchovies are put up with equal care in oil, which the country itself so plentifully supplies, and the bones are all carefully removed, a work of very considerable labor.

Amongst other things Messrs. Louit exhibit, in small, very prettily shaped glass barrels, a mustard of which they are the inventors, which they call "Moutarde Diaphane;" these barrels are so nice looking that they may be placed at once upon the table without the necessity of transference to a mustard pot. The reader must understand at the same time that French mustard, as we shall presently show, is a very different article from its English namesake. The chocolate of Messrs. Louit Frères will be noticed in another part of this report.

Messrs. Maille & Tandeau, like Messrs. Louit Frères, are manufacturers of vinegar and mustard, and preparers of pickles. When we visited their factory we witnessed the process of manufacture of French mustard. In the case of English mustard it is the interior or farina only of the seed of the brown and white mustard which is used; in the case of genuine mustard the farinas of these two kinds are mixed together in different proportions. A few years since a genuine or unmixed mustard was almost unknown in this country, but it is now largely manufactured by all the most considerable makers, although an article is still made and sold in large quantities as mustard which consists of a mixture of wheat flour, turmeric and mustard, with sometimes other and more objectionable substances. But French mustard is a very different article to either of these, and is thus prepared: While the English makers reject the husk of the seed, the French grind down into a fine powder or paste the whole of the seed, including the husk, and mix it with wine-vinegar, variously flavored, often with tarragon. The preparation thus made has the consistence of a thin paste, and is ready for use at table without further trouble. French mustard is more aromatic thus made, much milder, and less pungent than English mustard.

Much care and taste are likewise exercised by this firm in the selection of the vegetables intended for pickling, and their arrangement in the bottle. By this firm, also, the anchovies are deprived of the bones before being put up, and among other interesting operations we witnessed the preparation of the so-called "Olives farcies." The fleshy part of each olive down to the stone is removed by cutting round and round in the same way as one would peel an orange or apple in one long piece. The stone being thus taken out, the olive gathers itself up again by its own inherent elasticity into nearly its original form; the center formerly occupied by the stone is then stuffed with a piece of anchovy and a few capers, and this is the "Olive farcie." In this state they are put up into bottles in vinegar ready for the use of the chef, who adds them to many dainty dishes. The operation above described is, of course, tedious, and must add considerably to the cost. Other articles we noticed were "Moutarde Rouge," "Moutarde Verte aux Fines Herbes," and "Moutarde aux Truffes."

Mons. Beauhaire also exhibits samples of "Moutarde Rouge," the manufacture of this description of mustard being the specialty of his firm. In its preparation it would appear that vinegar is not used, but, in place of it, the juice of red grapes, to which the mustard owes its chocolate-red color. It is fragrant, and more pungent than French mustard usually is, and of an agreeable, fruity, acidulous taste.

Messrs. Pellier Frères are preservers on a very large scale of alimentary substances, both animal and vegetable—meats, fowls, game, fish of nearly all kinds, and a great variety of vegetables. They possess several manufactories, some of them established many years since; these are placed in the most convenient situations for obtaining a supply of the several articles preserved by them. To enumerate even the names of their different preparations would occupy pages; out of the extensive list the gourmand would be sure to find some things which would please even his fastidious taste.

In a communication with which Messrs. Pellier have favored us, they make the following important statement: "All our vegetables, peas, beans, and flageolets, are prepared without an atom of copper."

CURIOSITIES OF THE PARIS EXHIBITION.

AN exhibition usually possesses so broad a programme that it is difficult to bind it down to the original and somewhat limited objects of its establishment; and were it so bound down, it would detract very considerably from the necessarily grandiose aspect of such an undertaking. To make it merely a moral engine, a great educational and technical institution, "teaching by examples," as Dion Hallicarnassus hath it, would be to sternly eliminate from its galleries thousands of *vitrines* which contain objects more fitted for the museum than the exhibition, but which nevertheless are great attractions to visitors, and, if nothing else, add to the popularity and majesty of an institution which cannot complete its *rôle* if it is not grand and popular.

The present Paris Exhibition is no exception to this rule; indeed, it possesses more than any previous exhibition the characteristics of a museum. On every side are constantly to be seen curious and peculiar creations—examples of extreme magnitude, specimens of infinitesimal reduction, eccentric conceptions, complicated novelties, chemical vanquishers of time, machines laboriously contrived for the simplest purposes, others which obtain semi-miraculous results by means of the most ridiculous simplicity. Indeed, there are curiosities ranging over almost every industry, representative of nearly every country, and achieving ends hitherto undreamed of. There are many, indeed, which are perfectly useless, but they are monuments of ingenuity and skill, and all are to some extent educational, inasmuch as they aid in the development of a species of talent which at some future time may find utilitarian and valuable employment.

Take, for example, the creations of a few individuals whose tastes certainly approximate the *gigantesque*. There can be no doubt, of course, that at the present moment compression is an end much sought after in science and mechanics, but he would be indeed a bold prophet who would foretell that the days of gigantic production are over, and that future generations will not require to know how to make Brobdingnagian receptacles, and to produce material in Brobdingnagian proportions. In the Philadelphian Exhibition, for example, there was a cheese sufficiently large and thick to have been used as the foundation for a goodly-sized mansion. To turn out this monster sphere in symmetrical proportions was undoubtedly a labor which involved no inconsiderable amount of skill and ingenuity; and if at the present moment this skill and ingenuity can obtain no other useful employment, there can be no doubt that in the future it will find remunerative opportunities of application. Such opportunities must arise in the course of years, and when they do arise precedents and examples will be exceedingly valuable, almost indispensable. America, however, is the only land in which the utility of occasionally thus exercising one's ingenuity is thoroughly appreciated.

A MONSTER SAUSAGE.

A Florentine sausage maker exhibits in the Italian section of the present exhibition a sausage which weighs no less than 50 kilos., and which measures more than two yards in length. Of course, it is impossible to lay down in these narrow limits how far the brilliant intellect which evolved the scheme of this sausage will be able to benefit his fellow-creatures; but the fact remains that this intellect is responsible for an originality—it may be comic, even ridiculous, but still it is an originality—which must indicate a certain ability, and this ability, being distinguished, must effect some good. The

sausage is a memorial of this species of intellectual superiority; it is its creation, the concrete representative of its skill and ingenuity, and, as a precedent for similar creations in the future, is the gospel of a science. Such considerations may not occur to every one; but in discharge of our duties to the Exhibition as a great industrial institution we cannot divest our mind of the grand, educational mission which the French press is never tired of attributing to every feature in the enormous show in the Champ de Mars.

GREAT WINE BARRELS.

But let us put aside for a moment the *rieusque jocosque* which a consideration of these alimentary curiosities cannot fail to engender, and view two other curiosities, really of a nature elevative of industry, which are to be seen among the wine exhibits of two great wine countries—France and Hungary. These consist of two monster tuns, one capable of holding 60,000 liters, and the other boasting a capacity of 100,000 liters. The first is due to a French mind. It is said to be full of champagne, and is appropriately decorated with sculptured panels bearing the heraldic attributes of the principal towns of Champagne, while above a smiling, rotund, alluring little Bacchus leans on a vase filled with luscious grapes, and invitingly holds aloft a cup. The other has also been designed by a Frenchman—M. Leon Redoux, of Paris—but it is exhibited by a certain vinously inclined Magyar, Herr Gutmann by name, whose residence is in North Kunitza. Herr Gutmann, apparently, does not believe in ostentatious magnificence of which spectators and the public do not have full benefit. His tun, unlike that of his French competitor, contains only 100,000 liters of musty air; but it is built of splendid oak, is a magnificent specimen of coopering, and is beautifully carved and ornamented in that quaint and impish fashion so distinctive of German art decoration.

These curiosities are, in an educational sense, somewhat more valuable than those gastronomic monsters on which we erst dilated. The knowledge that a species of skilled workmanship, such as coopering, can be applied to such enormous constructions must be of great interest to industry, and the ornamentation with which they are decorated are splendid specimens of decorative wood carving, equally worthy of a place in the Exhibition with other carvings which are only displayed in consequence of their intrinsic merit. It would probably be more difficult to find a practical value for the capacity of these monstrous receptacles, and without, Duke of Clarence like, they are to be used as humane instruments for capital punishment, we must confess our inability to find one.

A LONG RAIL.

This drawback is not applicable to the gigantic character of another curiosity which is exhibited in the machinery gallery of the Belgian section. This consists of two rails, one of which is a solid piece of metal 55 meters in length (155 feet), and the other, of the same extraordinary length, is coiled up in a spiral roll. These rails, which were made at the Seraing Works of M. Cockerill, are excellent representatives of the perfection to which the Belgian metal industries have been raised, and which in recent years has stimulated much curiosity as to the metal resources, both natural and ingenious, which are possessed by the small Flemish kingdom.

Together with these remarkable rails is exhibited the machine which constructed them. It is so arranged as to allow the steam to be shut off and the piston turned in an opposite direction without a moment's delay. These rails are interesting and valuable curiosities, over which we hope that not only English ironmasters will carefully ponder, but also some of those British workmen whose conceptions of the injurious nature of strikes require some development. The anticipation that these curiosities have at all a utilitarian or educational value is at best somewhat extravagant.

The same criticism is, however, not so applicable to the other extreme—to those curiosities which aim at the production of works in miniature. The ingenuity displayed in such work has undoubtedly a great and immediate value for industry. This is especially apparent while wandering in the galleries devoted to the exhibits of Chinese, Japanese, Indian, and other Oriental workmen. The minute work which is there displayed is very beautiful, and in an age when compression has become almost a rage there can be no doubt that such work has its useful place in the general system.

The same ingenuity which, in a highly materialistic sense, is wasted on the elaborate carvings of ivory, sandalwood, ebony and tortoise shell, in which Oriental artists indulge, has trained the eye for the production of such useful work as Eastern shawls and carpets, in many of which there are no less than 10,000,000 stitches. It is, therefore, to some extent congratulatory that specimens of similar ingenuity are not absent from the Western sections.

ONE HUNDRED KNIVES IN A CHERRY STONE.

In one of the French galleries, for example, there is a marvel of labor and industry which has been manufactured by a cutler of Montron, in the department of the Dordogne. It consists of 100 microscopic knives inclosed in an ordinary sized cherry stone! They have all boxwood handles, open and shut in the ordinary way, and yet they do not weigh more than seven grains in all.

THE SMALLEST BOOK.

Again, in the Italian section is a wonder of typography in the shape of the smallest book that has ever been printed in any language. The extraordinary nature, however, of this curiosity does not arise from its minute size, as books much smaller could easily be turned out; but what is so especially remarkable about it is the magnitude of its contents, containing as it does the whole of Dante's *Divina Commedia*. It has been printed in Padua, and is so small that, although handsomely bound in red velvet and silver, it may easily be worn as a charm hanging from the watch chain.

MODEL OF THE NEW YORK POST OFFICE.

The American section also exhibits a specimen of minute work in the shape of a model of the New York Post-Office, constructed on the scale of one thirty-second of an inch to the foot. It contains 284,000 pieces, and has been built from plans, occupying the time of one man, working six hours a day, for six years. The extreme value of such minute work is contained in the fact that as literary labor, for example, multiplies and increases every day, it may be necessary eventually to compress its productions within very small compass; and as Edison, the celebrated inventor, has been heard to declare that mechanics can be so elevated and perfected as to provide almost supernatural retinæ for the eyes, Macaulay's typical New Zealander may be enabled to carry in his waistcoat pocket a complete edition of the ancient British classics, which he may peruse with an artificial eye of "hextra double million magnifying power," as Sam Weller would say.

A BUST IN SOAP.

At any rate, however useless these curiosities may be, they may have the satisfaction of knowing that in an industrial sense they are not the most useless in the Exhibition. What, for example, is the value, in the infinity of human improvement, of a bust of M. Leon Say done in soap, as a testimony of gratitude to that statesman from the soapmakers of Marseilles, for the conspicuous part he took in the repeal of the soap tax? The bust is certainly very artistically cut by M. Barnabo, and so is also the magnificent imitation marble trophy in soap which is exhibited in the Austrian section; but their artistic treatment does not make them any more useful.

A CLOCK MADE OF BREAD.

The same may be said of a clock made entirely of bread, which has been sent from Milan to the Italian section. The maker is a Peruvian, a native Indian, who during three years of his life devoted a goodly portion of his leisure to the construction of his curiosity. He used only the crumb of the bread, which he hardened with a certain salt, and which is said to have rendered it insoluble in water. The clock is certainly well executed, and goes very well, but people will as little think of using hardened bread for clock cases or mechanism as of attempting to hand down to posterity graven images of themselves done in soap.

OTHER CURIOUS THINGS.

What also is the practical value of Messrs. Osler's crystal throne—beyond the beauty of its ornamentation—without it is to teach, as a French contemporary has suggested, how fragile are the thrones of princes in these revolutionary days; or the elaborate boat which natives of Guatemala have carved out of a solid piece of mahogany, 22 feet long, and which weighs some 15 tons; or the handsomely ornamented cabinet, covered with garlands in copper, with medallions and translucid enamels, which was presented to the Pope by a large number of subscribers, and which contains the celebrated bull of the immaculate conception translated into sixty languages; or of the album in which are to be found specimens of the different kinds of handwriting of all the periods between the seventh and eighteenth centuries? There are some people, however, who may find some use for the artificial baby made of India-rubber, which is exhibited in the American section, and which, on being squeezed, imitates the crying of a child to the life. How well might any one, with the assistance of such a "little dear," frighten away obnoxious passengers from a railway carriage. A squeeze, and, presto! they would be gone.

It must not, however, be imagined from this enumeration of useless or semi-useless creations that the Exhibition does not contain some very notable curiosities, designed to occupy an important place in the world of utility. There are a large number of ingenious machines—more than we could possibly describe in our limited space—which deserve to rank as curiosities, if only for the efficiency and celerity with which they effect enormous savings of time in various processes.

There are, for example, in the French agricultural section an apparatus which makes butter in less than a minute, a machine which milks cows "mechanically, without touching them," an arrangement of circular knives which peels potatoes beautifully, and all the time-honored but still very curious steam incubators and poultry fatteners which are so indissolubly associated with Norman farmyards.

In the tobacco industry kiosque there are also some curious machines. There is one for the manufacture of cigarettes, which is really of extraordinary efficiency. The extremity of an endless coil of paper is placed in a certain slit, and then, by means of continually turning certain cogwheels, the machine cuts the paper, fills it with tobacco, rolls it, gums it, and discharges it into a box in an incredible space of time.

Another machine is still more amusing. This is designed for packing tobacco. The packet ready to be finished off is placed in an orifice, whence it is immediately afterward vomited, beautifully and artistically completed; but, curiously enough, this machine refuses to pack any but correct weights, and if there is either a grain too much or too little of tobacco, the packet is pitilessly returned, unfinished.

THE STEAM VELOCIPEDE.

From a contemplation of this amusing apparatus it is but a step to walk toward the Hangar du Quai de Billy, in which is situated what is erroneously designated as a "steam velocipede." This machine is the invention of a certain M. Perraux, who has evidently come to the conclusion, long since arrived at by one of our greatest philosophers, that steam is a power which can with advantage be applied to all our daily wants. By means of his steam velocipede every man may be enabled to substitute a tricycle for a brougham and a boiler for a horse, and travel to the city from his suburban residence in less than half the usual time. There is, unfortunately, one drawback to this invention, which will effectually prevent its employment for every day use, and that is, that, as the boiler is treated by alcohol in a state of combustion (as in a spirit tank), the value of the spirit thus consumed is at the rate of two shillings an hour.

And so, in the different sections and galleries of the Exhibition, there are thousands of interesting novelties and curiosities, some vainglorious exhibitions of useless skill, many, on the contrary, eccentric contrivances for the attainment of beneficial results. They all, however, serve to indicate some progress, and in such a sense they are worthy the study of every visitor. The gigantic creations are indicative of some improvement in the means of their production; the minute work shows the perfection of a certain delicacy of manipulation which is every day becoming more and more indispensable in the realms of industry and art, and the more useful curiosities are as such distinguished in the Exhibition as obtaining new results or improving upon ancient processes.—*British Trade Journal.*

THE PARIS EXHIBITION — EXHIBIT OF THE ROYAL MANUFACTORY OF COURT WAX LIGHTS, OF BRUSSELS.

The Joint Stock Company of Court Lights (Manufacture Royale des Bougies de la Cour) exhibits in a large glass case (class 47) specimens of its manufacture of all kinds and at all prices. This old established company was founded in 1833, by M. J. Quanonne, to use the processes recommended by M. de Milly. The present system of manufacture was adopted in 1854, when all the stock and plant were renewed. The importance of the machinery may be estimated when it is known that seven generators of 500 horse power, and four machines, worked by steam of 60 horse power, are used, besides nine distilling apparatus, 18 cold and 14 hot pressing machines, for producing stearine, and many other machines used in preparing the glycerine, etc. The company is said to absorb annually about 5,000,000 francs in preparing candles for exportation alone. In Australia these candles are sold under the name of "Roubaix-Jenar." They are also exported to various parts of Europe, Asia, Africa, and America.

A sulphuric decomposition forms the basis of the manufacture of these lights. The distillation is effected in cast-iron retorts with the aid of superheated steam. The chief matters employed are tallows and palm oils of all kinds, and of late a new fatty matter, called *Shea butter*, obtained from the almonds of a tree growing in Central Africa, has been introduced. This tree, though long known, was met with originally in the East Indies by Kotschy, who described and named it the *Butter Tree*, but it had not been utilized in Europe. The different exploring societies met with it in various latitudes of Central and Equatorial Africa. Colonel Grant found large quantities of these trees at Lovemba, in Bambara.

Oliver, in the "Transactions of the Linnæan Society of London," describes the tree as being about 30 feet high, and called *Meepampa* by the natives. The wood is red, and so hard that it is difficult to cut with hatchets. The bark is very thick, and divided into longitudinal segments. When an incision is made in the bark a quantity of milky sap flows from it, which becomes a hard white gum when dry, and which is evidently largely used by the natives, since nearly all the trees found in the neighborhood had been deprived of their bark. The tree flowers in December, the blooms hanging in tufts at the extremities of the branches. The fruit when ripe is a nut of the size of a large pigeon's egg. Under a thin husk is a pleasant-tasting pulp which covers the almond from whence the butter is obtained. The almonds, after being dried in the sun, are crushed and put in large earthen pots, where they are boiled with water. The grease which rises to the top is skimmed off, and forms when cold a white substance of the consistency of butter, with a delicate aroma.

It can be preserved for some time without becoming rancid, for which property it is much appreciated by the natives as an aliment. Its balsamic odor proceeds from a peculiar resin which it contains, and which possesses certain medicinal properties, since it is greatly used by the negroes for eruptions and rheumatism. This grease, when subjected to concentrated sulphuric acid and distilled, gives off fat acids of an oily appearance. Under pressure a valuable stearic acid is obtained at a fusion of 65°. Unfortunately, this stearine is not sufficiently firm to be employed pure in the manufacture of lights, although it contracts considerably at a low temperature, a property which allows of its being very advantageously mixed with paraffin or other bodies which do not sensibly shrink. It is believed that no other acid fat absorbs so much latent heat. It is difficult to obtain this stearine white by ordinary methods; the spongy structure preserves, even under the action of the hot press, the resin which colors it. Subjected to heated alcohol it leaves a deposit of pearly scales, which might be mistaken for boracic acid spangles.

In December, 1877, large quantities of this vegetable butter were introduced for the first time, and it is probable that its use will be largely extended, especially if, instead of importing the grease, we import the almonds themselves. A valuable comestible butter would be thus obtained which can be preserved for two years without becoming rancid. A fine white firm soap, producing no lather, can also be made from it, and manufacturers of stearine will find it a valuable acquisition when they have discovered an easy method for working it.

The company calls the attention of the jury to the products obtained from the butter which have never been shown at any previous Exhibition, and especially to its employment in the *Bougies de la Reine*, the coagulation of which had previously been obtained by calcareous saponification. The Royal Manufacture obtains these stearines by mixing compressed stearines with a certain quantity of aqueous spirit, which dissolves oily matters, but in which the stearine is almost insoluble. The spirit easily takes in the oily substance by the precipitation of a small proportion of water. Besides the national prizes gained by this society in Belgium in 1838, 1841, and 1847, it also gained first prizes at the London International Exhibitions of 1851 and 1862. At the close of the Exhibition of 1867 the Belgian Government awarded the Cross of Leopold to M. de Roubaix-Jenar, who was at that time the managing director of the company. We hear that the jury have decided to bestow a gold medal upon the company in the present Exhibition.—*Illustrated Paris Exhibition.*

SALTS OF IRON FOR HARDENING OR STEELING COPPER PLATES.

By Prof. Böttger.

In the employment of copper plates for printing, whether in a photo-mechanical or other analogous process, it is very necessary that the surface thereof should be hard and steel-like. Plates may be hardened by depositing a surface of iron by the electrotype process, but the method is a tedious and long one. Again, in the decomposition method of mine, it is possible, when the plates have been worn by printing, to remove the film by muriatic acid, and again coat the plate evenly in a few minutes.

The double sulphate of iron and ammonia is what I used to employ in my steeling of copper plates, and this is a method still adopted by many; it is only lately, indeed, that I have observed that an iron solution prepared in the manner following is better adapted for the purpose:—You dissolve, in the first place, ten grammes of so-called yellow prussiate of potash and twenty grammes of tartrate of soda or potash in two hundred cubic centimeters of distilled water, and add to the solution three grammes of sulphate of iron dissolved in fifty cubic centimeters of water. In this way there is precipitated a good deal of Prussian blue. If now there is added, drop by drop, to the above, a solution of caustic soda, taking care meanwhile to stir vigorously with a glass rod, until the blue precipitate has disappeared again, then you obtain a perfectly clear and slightly yellowish fluid, which can be employed at once for steeling copper plates.

This fluid can also be employed, without the medium of a mordant, to dye woolen articles of a beautiful blue.—*Photographische Notizblatt.*

ANIMAL INTELLIGENCE.

ANIMAL intelligence, said Mr. Romanes, in a recent lecture in Dublin, is a subject which has always been of considerable interest to philosophical minds, but, as most of you are probably aware, the interest attaching to this subject has of late years been greatly increased by the significance which it has acquired in relation to the theory of descent. As human intelligence is the only order of intelligence with which we are directly acquainted, and as it is moreover the highest order of intelligence known to science, we may most conveniently adopt it as our standard of comparison. When I allow my eyes to travel over this vast assembly, my mind receives, through their instrumentality, a countless number of impressions. So far as these impressions enter into the general stream of my consciousness, they constitute what are called perceptions. Suppose, now, that I were to close my eyes, and to fix my attention on the memory of some particular perception which I have just experienced—say the memory of some particular face. This mental image of a perception would be what is called an idea. Lastly, suppose that I were to analyze a number of the faces which I have perceived, I should find that, although no two of them are exactly alike, they all bear a certain general resemblance to one another. Thus from the multitude of faces which I now perceive it becomes possible for my mind to abstract from them all the essential qualities of a face as a face; and such a mental abstraction of qualities would then constitute what I might call my abstract idea of a face in general, as distinguished from my concrete idea, or memory, of any face in particular. Thus, then, we have three stages:—1st, that of immediate perception; 2d, that of ideal representation of particular objects; 3d, that of a generalized conception, or abstract idea, of a number of qualities which a whole class of objects agree in possessing. It will be convenient to split the latter division into two subdivisions—viz., abstract ideas which are sufficiently simple to be developed without the aid of language, and abstract ideas which are so complex as not to admit of development without the aid of language. As an instance of the former class of abstract ideas we may take the idea of food. This is aroused in our minds by the feeling of hunger; and while the idea when thus aroused is clearly quite independent of language, it is no less clearly what is called an abstract idea. For it is by no means necessary that the idea of food which is present to the mind should be the idea of some special kind of food; on the contrary, the idea is usually that of food in general, and this idea it is which usually prompts us to seek for any kind of food in particular. Simple abstract ideas, therefore, may be formed without the assistance of language; and for this reason they are comprised within what Lewes has called the logic of feelings. But abstract ideas of a more elaborate type can only be formed by the help of words, and are therefore comprised within what Lewes has called the logic of signs.

Now, with regard to ideas themselves, I need only add that they are the psychological units which compose the whole structure intellectual. They constitute, as it were, the raw material of thought, which may be elaborated by the reflective faculty into various products of thought. Once formed they present an essential property of occurring in concatenated series; so that the occurrence of one idea determines that of another with which it has been previously joined. This principle of the association of ideas, manifested as it is by the ultimate units of intellectual structure, is by far the most important principle in psychology; it is the principle which renders possible all the faculties of mind—memory, instinct, judgment, reason, emotion, conscience, and volition.

Mr. Romanes then proceeded to give an elaborate analysis of the psychological basis of mind, and in taking leave of that part of his subject he pointed out that in recognizing the indisputable fact of mind having such a basis we are not necessarily committing ourselves to the doctrine of materialism. That psychical phenomena are very intimately associated with physical phenomena is a fact which does not admit of one moment's dispute; but concerning the nature of this association science must declare, not merely that it is at present unknown, but that, so far as she is at present able to discern, it must forever remain unknowable. Passing on now to our review of comparative psychology, the first animals in which, so far as I can ascertain, we may be quite sure that reflex action is accompanied by ideation, are the insects. For Mr. Darwin has observed that bees remember the position of flowers which they have only several times visited, even though the flowers be concealed by intervening houses, etc. Sir John Lubbock also has shown that, after a very few individual experiences, bees are able to establish a definite association between particular colors on paper and food; and further that, after a very few lessons, a bee may be taught to find its way out of a glass jar. These observations would seem to prove that the grade of intelligence is higher in some articulata than it is among the lower vertebrata. For many of you will probably remember the experiment of Professor Möbius, which proved that a pike requires three months to establish an association of ideas between particular kinds of prey and the fact of their being protected by an invisible wall. This fact was proved by the pike repeatedly dashing its nose against the glass partition in its tank in fruitless efforts to catch minnows which were confined on the other side of the partition. At the end of three months, however, the requisite association was established, and the pike, having learned that its efforts were of no use, ceased to continue them. The sheet of glass was then removed; but the now firmly established association of ideas never seems to have become disestablished, for the pike never afterward attacked the minnows, though it fed voraciously on all other kinds of fish. From which we see that a pike is very slow in forming his ideas, and no less slow in again unforming them. As regards the association of ideas by the higher vertebrated animals, it is only necessary to say that in all these animals, as in ourselves, this principle of association is the fundamental principle of their psychology; that in the more intelligent animals associations are quickly formed, and when once formed are very persistent; and, in general, that so far as animal ideation goes, the laws to which it is subject are identical with those under which our own ideation is performed. Let us then ask, how far does animal ideation go? The answer is most simple, although it is usually given in a most erroneous form. It is usually said that animals do not possess the faculty of abstraction, and therefore that the distinction between animal intelligence and human intelligence consists in this—that animals are not able to form abstract ideas. But this statement is most erroneous. You will remember the distinction which I laid down between abstract ideas that may be developed by simple feelings, such as hunger, and abstract ideas that can only be developed by the aid of language. Well remembering this distinction, we shall find that the only difference between animal intelligence and human intelligence consists in this—that animal intelligence is unable to elaborate that class of abstract ideas, the formation of which depends upon the faculty of speech. In other words, animals are quite as able to form abstract ideas as we are, if under abstract ideas we include general ideas of qualities which are so far simple as not to require to be fixed in our thoughts by names. For instance, if I see a fox prowling about a farmyard, I cannot doubt that he has been led by hunger to visit a place where he has a general idea that a number of good things are to be fallen in with, just as I myself am led by a similar impulse to visit a restaurant. And, to take only one other instance, there can be no question that animals have a generalized conception of cause and effect. For example, I had a setter dog which was greatly afraid of thunder. One day a number of apples were being shot upon the wooden floor of an apple-room, and as each bag of apples were shot it produced through the rest of the house a noise resembling that of distant thunder. My dog became terror-stricken at the sound; but as soon as I brought him to the apple-room and showed him the true cause of the noise, he became again buoyant and cheerful as usual. Another dog which I had used to play at tossing dry bones to give them the appearance of life. As an experiment I one day attached a fine thread to a dry bone before giving him the latter to play with; and after he had tossed the bone about for a while as usual, I stood a long way off and slowly began to draw it away from him. So soon as he perceived that the bone was really moving on its own account his whole demeanor changed, and, rushing under the sofa, he waited horror-stricken to watch the uncanny spectacle of a dry bone coming to life I have also greatly frightened this dog by blowing soap bubbles along the floor; one of these he summoned courage enough to touch with his paw, but as soon as it vanished he ran out of the room terrified at so mysterious a disappearance. Lastly I have put this dog into a paroxysm of fear by taking him into a room alone and silently making a series of horrible grimaces. Although I had never in my life hurt this dog, he became greatly frightened at my unusual behavior, which so seriously conflicted with his general idea of uniformity in matters psychological.

Of course in thus claiming for animals the power of forming general conceptions, I mean only such general conceptions as can be arrived at by the logic of feelings. So far, then, as the logic of feelings can carry them, I maintain that the intellectual operations of animals are indistinguishable from those of ourselves. My friend, Dr. Rae, the well-known traveler and naturalist, knew a dog in Orkney which used to accompany his master to church on alternate Sundays. To do so he had to swim a channel about a mile wide; and before taking to the water he used to run about a mile to the north when the tide was flowing, and a nearly equal distance to the south when the tide was ebbing, "almost invariably calculating his distance so well that he landed at the nearest point to the church." In his letter to me Dr. Rae continues:

"How the dog managed to calculate the strength of the spring and neap tides at their various rates of speed, and always to swim at the proper angle, is most surprising."

So much, then, for judgment. For some good instances of reasoning in animals I am also indebted to Dr. Rae. Desiring to obtain some Arctic foxes, he set various kinds of traps; but, as the foxes knew these traps from previous experience, he was unsuccessful. Accordingly he set a kind of trap with which the foxes in that part of the country were not acquainted. This consisted of a loaded gun set upon a stand pointing at the bait. A string connected the trigger of the gun with the bait, so that when the fox seized the bait he discharged the gun, and thus committed suicide.

In this arrangement the gun was separated from the bait by a distance of about 30 yards, and the string which connected the trigger with the bait was concealed throughout nearly its whole distance in the snow. The gun-trap thus set was successful in killing one fox, but never in killing a second; for the foxes afterward adopted either of two devices whereby to secure the bait without injuring themselves. One of these devices was to bite through the string at its exposed part near the trigger, and the other device was to burrow up to the bait through the snow at right angles to the line of fire, so that, although in this way they discharged the gun, they escaped with perhaps only a pellet or two in the nose.

Now both of these devices exhibited a wonderful degree of what I think must fairly be called power of reasoning. I have carefully interrogated Dr. Rae on all the circumstances of the case, and he tells me that in that part of the world traps are never set with strings; so that there can have been no special association in the foxes' minds between strings and traps. Moreover, after the death of fox number one, the track on the snow showed that fox number two, notwithstanding the temptation offered by the bait, had expended a great deal of scientific observation on the gun before he undertook to sever the cord.

Lastly, with regard to burrowing at right angles to the line of fire, Dr. Rae justly deemed this so extraordinary a circumstance that he repeated the experiment a number of times in order to satisfy himself that the direction of the burrowing was really to be attributed to thought and not to chance.

Passing on to the emotional life of animals, we find that this is very slightly, if at all, developed in the lower orders, but remarkably well developed in the higher—that is to say, the emotions are vivid and easily excited, although they are shallow and evanescent. They thus differ from those of most civilized men in being more readily aroused and more impetuous while they last, though leaving behind them but little trace of their occurrence.

As regards the particular emotions which occur among the higher animals, I can affirm from my own observations that all the following give unmistakable tokens of their presence: Fear, affection, passionateness, pugnacity, jealousy, sympathy, pride, reverence, emulation, shame, hate, curiosity, revenge, cruelty, emotion of the ludicrous, and emotion of the beautiful.

Now this list includes nearly all the human emotions except those which refer to religion and to the perception of the sublime. These, of course, are necessarily absent in animals, because they depend upon ideas of too abstract a nature to be reached by the mind when aided by the logic of signs.

Of course the moral sense as it occurs in ourselves involves ideas of high abstraction, so that in animals we can only expect to meet with a moral sense in a very rudimentary form; and, therefore, even if it is true that no indications of such a sense are to be met with in animals, the fact would not establish any difference in kind between animal intelligence and human. But I am inclined to believe that in highly-intelligent, highly-sympathetic, and tolerably well-treated animals, the germs of a moral sense become apparent

To give an instance, a Skye terrier I had was only once in his life known to steal; and on this occasion, when very hungry, he took a cutlet from a table and carried it under a sofa. I saw him perform this act of larceny, but pretended not to have done so, and for a number of minutes he remained under the sofa with his feelings of hunger struggling against his feelings of duty. At last the latter triumphed, for he brought the stolen cutlet and laid it at my feet. Immediately after doing so he again ran under the sofa, and from this retreat no coaxing could draw him. When I patted his head he turned away his face in a ludicrously conscience-stricken manner.

St. George Mivart has said that an interesting book might be written on the stupidity of animals. I am inclined to think that a still more interesting book might be written on the stupidity of savages. Now there is no doubt that the interval which separates the most degraded savages from the most intelligent animal is, psychologically considered, enormous; but enormous as it is, I cannot see any evidence to show that the gulf may not have been bridged over during the countless ages of the past. Abstract ideas among savages are mostly confined to such as may be formed by the logic of the feelings.

In comparing the intelligence of a young child with that of an adult animal we are met with this difficulty—that as the bodily powers of children at so immature an age are so insufficiently developed, the mind is not able, as in the case of animals, to accumulate experiences of life. In order, therefore, to obtain a fair parallel, we should require a human being whose mental powers have become arrested in their development at an early age, while the bodily powers have continued to develop to mature age, so serving to supply the aborted human intelligence with full experiences of life.

Now, the nearest approach that we have to these conditions is to be found in the case of idiots. As there are all degrees of idiocy, the object of my inquiry was to determine the order in which the various mental faculties become enfeebled and disappear as we descend from the higher to the lower grades of imbecility. Beginning from below, the first dawn of intelligence in the ascending scale of idiots, as in the ascending scale of animals, is invariably to be found in the power of associating simple concrete ideas. Thus there are very few idiots so destitute of intelligence that the appearance of food does not arouse in their minds the idea of eating; and, as we ascend in the scale idiotic, we find the principle of association progressively extending its influence, so that the mind is able, not only to establish a greater and greater number of special associations, but also to retain these associations with an ever-increasing power of memory.

Again, the faculty of reason is dwarfed to the utmost—so much so that the investigator is most of all astonished at the poverty of rational power which may be displayed by a human mind that in most other respects seems well developed. A boy, 14 years of age, belonging to the highest class of undoubted idiots, could scarcely be called feeble-minded as regarded many of his faculties. His powers of mental calculation were quite equal to those of any average boy of his age. Yet he was not able to answer any question that involved the simplest act of reason.

From the mental condition of uneducated deaf mutes we learn the important lesson that in the absence of language the mind of a man is almost on a level with the mind of a brute in respect of its power of forming abstract ideas. I have, therefore, no hesitation in giving it as my opinion that the faculty of speech is alone the ultimate source of that enormous difference which now obtains between the mind of man and the mind of the lower animals. Is this source of difference adequate to distinguish the mind of man from the mind of the lower animals in kind? I leave you all to answer this question for yourselves.

I am satisfied with my work if I have made it clear to you that the question whether human intelligence differs from animal intelligence in kind or in degree hinges entirely on the question whether the faculty of speech has been of an origin natural or supernatural. We are living in a generation which has witnessed a revolution of thought unparalleled in the history of our race. I do not merely allude to the fact that this is a generation in which all the sciences, without exception, have made a leap of progress such as widely to surpass all previous eras of intellectual activity; but I allude to the fact that in the special science of biology it has been reserved for us to see the first rational enunciation, the first practical demonstration, and first universal acceptance of the doctrine of evolution.

And I allude to this fact as to a fact of unparalleled importance in the history of thought, not only because I know how completely it has transformed the study of life from a mere grouping of disconnected observations to a rational tracing of fundamental principles, but also because it is now plainly to be foreseen that what the philosophy of evolution has already accomplished is but an earnest of what it is destined to achieve; and, forasmuch as this enormous change in our means of knowledge and our modes of thought has been so largely due to the almost unaided labors of a single man, I do not hesitate to say, even before so critical an audience as this, that in all the history of science there is no single name worthy of a veneration more profound than the now immortal name of Charles Darwin.

THE MOVEMENTS OF FLYING FISH THROUGH THE AIR.

THESE movements form the subject of an interesting paper recently contributed by Prof. Möbius to the *Zeitschrift für wissenschaftliche Zoologie* (Band xxx., suppl., p. 343; see *Naturforscher*, June 8, 1878). From his own observations (made during a voyage to Mauritius, *via* Suez, and back by the Seychelles) and the observations of others, he describes the principal features of the phenomenon thus:

The exocœti dart with great velocity out of the water without regard to the direction of the wind and the course of the waves.

They do not, during their flight, make any regular fluttering movements with their pectoral and ventral fins, but hold them spread out. In the outspread fins there may occur very rapid vibrations.

The hinder part of the body remains somewhat lower than the fore part during flight.

Directly against the wind they commonly fly further than with the wind, or when their course and the direction of the wind form an angle together.

Most exocœti which fly against the wind or with the wind continue during their whole course of flight in the direction in which they come out of the water. Winds coming laterally upon the original course of the exocœti deflect these into their direction.

All exocœti which withdraw from ships fly during their

whole course through the air, near the surface of the water.

When with strong winds they fly against the course of the waves, they commonly rise somewhat over each wave; sometimes their tail dips slightly in the top of the wave.

Only those exocœti whose air-course is crossed by a ship rise to considerable heights (at the most about five meters above the surface of the sea).

By day flying fish seldom light on the ship; they mostly do so at night, and never in calm, but only when the wind is blowing. They mostly fall upon ships which lie not higher than two to three meters above water, and when these are sailing on a wind (the wind coming obliquely from beyond) or with half a wind (the wind coming at right angles against the ship), and are sailing rapidly. Flying fish never come on board from the lee side, but always and only from the weather side.

Not uncommonly when their tail has dipped in the water they describe, in the horizontal part of their course, a bow to the right or to the left side.

During wind and a rough sea they appear above the water more frequently than in calm weather.

Before ships, which come upon them in swimming, the exocœti escape into the air, just as they do before fishes of prey and cetacea.

Many authors have affirmed, in explaining the flying of fish, that the pectoral fins operate like the wings of birds, bats, and of insects. Prof. Möbius, however, shows that both the anatomical structures of the pectoral fins and their muscles, and the physiological relations of the position and size of the fins to the volume and weight of the whole body, are against flight-like movements of the pectoral fins.

The movements occasionally observed in these organs during flight are merely a vibration.

The true cause of these movements of fishes through the air are the spring movements which they impart to their body by means of their very strong side muscles, just as other fish propel themselves powerfully through water. They spring out of the water with great velocity, because the air presents less resistance than the water, and when after some time, they fall back into the water, their outspread fins act like a parachute.

It is easy to understand how the action of the wind combines favorably or otherwise with their flight. By day the direction of their spring is so chosen that the disturbing ship is avoided. By night this orientation by the sense of sight is wanting, and the animals fall into the ship. As any air in strong motion, when it impinges against obstacles (a ship's side or waves), rises, it raises also the fish, so that this flies over the wave, or may come on board the ship. In short, as Prof. Möbius proves in detail, all the phenomena observed may be fully explained by the combined action of the oblique projection forwards and the wind. It may further be mentioned that the flying fish has a peculiar arrangement of the mouth, so that in this a portion of water may be carried during flight for the process of respiration.—*Nature.*

PARAFFIN SPLINTS.

By William Macewen, M.D., Surgeon Royal Infirmary, Glasgow.

Having for some years past used paraffin for the formation of splints, and having found it possessing considerable advantages, I desire to bring its properties under the notice of surgeons.

At the outset I found that the results obtained by the use of paraffin were variable, uncertain, and untrustworthy. At times a splint might be obtained which was all that could be desired; at others the splint was soft and totally unsuitable. Thinking that this variability might have been due to some impurity in the article, pure specimens were obtained; but this in no way abolished the defects. During these experiments it was found that some specimens melted in five minutes, while others required, when exposed to the same heat, nearly double that time. Again it was ascertained that those specimens which took longest to melt retained their heat longer, and became ultimately harder than the paraffins which melted at a lower temperature. On mentioning these facts, as defects, to the manufacturer, it was found that the first was a well-known quality of paraffin, and that the maker could, in the process of manufacture, produce a paraffin having any desired melting point, from 75° to 150° F. A supply of specimens ranging from 110° to 130° F. was obtained, and a systematic series of experiments were conducted in order to ascertain the most suitable melting point. It was found that the paraffin having a melting point of 110° F. was most agreeable to the patient, but that the splints formed of it were soft, as long as it was kept at the temperature of the body. The high melting point paraffins made the hardest, firmest splints, but their application could not be borne by the patient in consequence of the heat. Under these circumstances one of two causes was necessary: either to discard the paraffin having a high melting point, or to alter the mode of application. At that time the paraffin was merely brushed over the surface of the bandages after they had been applied to the limb, consequently the limb received the heat, and became painful if a paraffin with a melting point of 130° F. was used. Another disadvantage of that method of application was that the bandages were very apt to receive only a superficial coating of paraffin, which formed a crust over the surface and was apt to crack when cool; this was most likely to occur if cotton bandages were used. After many different plans were tried, it was found that soaking gauze bandages in the paraffin and applying them to the limb as an ordinary roller obviated the difficulty of causing the patient to feel the heat, and at the same time it produced a much firmer and more compact splint than the old method. If a semi-elastic bandage is required, the surgeon should order the manufacturer to forward a paraffin with a low melting point, say 110° F.; but if he desire a firm immobile splint, let him order a paraffin with a melting point of 130° F. It should be perfectly pure; those having an odor of naphtha are not so, and consequently ought not to be used. It is the ordinary commercial solid paraffin which is supplied. It is formed in blocks, and is a perfectly odorless, translucent or whitish neutral solid substance. In this state it remains for any length of time without suffering from atmospheric exposure; water or moisture has no effect upon it; in fact, it is almost indestructible except by burning.

When the paraffin is required for use, the first step is to liquefy it. In order to hasten the process of liquefaction the block should be scraped down with a knife or broken into small pieces with a hammer. It may be liquefied in various ways, but the simplest and most cleanly is to place the paraffin in a vessel, which should then be immersed in another containing boiling water. These two vessels may be placed on a table with something covering them, and, if well managed, the paraffin will be found melted in from ten to fifteen minutes, or even less. The gauze bandages, previously rolled and ready for application, should then be dropped into the melted paraffin, and in five minutes they become saturated. They are then lifted, the superabundant paraffin gently pressed from them, placed on a plate, and when sufficiently cool to be handled by the surgeon he takes them up and applies them to the limb. The nurse may have the bandages quite ready for the surgeon, who has then only to apply them to the part. A dry gauze bandage ought first to be applied to the limb, to prevent the paraffin bandage from adhering. If a very firm splint is desired, a coating of hot paraffin may be brushed over the bandage after two or three layers of the roller have been applied to the limb—just in the same way as one would do in making a starch bandage, in which case he would apply a starched roller first, and then rub a quantity of starch round the limb before applying a second. The splint begins to cool in a few minutes after application; but the cooling may be hastened or retarded at will, by allowing or preventing a free current of air to play over it. In about fifteen minutes to half an hour it will become firm and solid. The bandage spoken of may be made of ordinary coarse gauze, or of any thin loose material which will form a framework for and retain a quantity of the paraffin in its meshes. If the splint be required for a compound fracture, the antiseptic gauze may be used, and in this way an antiseptic, or at least a neutral, splint may be obtained. If windows or apertures be wanted, these may be cut out with a pair of ordinary dresser's scissors immediately after the splint has been adjusted, before it is quite solid. If, for any purpose, a splint is required to be removed from a limb, this may be done while the splint is still warm by a pair of dresser's scissors. Holes may be punctured in the splint and the apparatus readjusted, and afterward held firmly together by a lace. After the splint has become firm and solid it may be cut with a sharp pocket-knife, though this is not so easy as cutting with scissors while the splint is still soft.

Paraffin splints do not shrink or contract on the limb in the same way as starch and plaster of Paris bandages do. This at first sight might seem strange, as every body contracts as it cools, and paraffin forms no exception to this rule. But this apparent contradiction may be explained by bearing in mind that the first part to cool is the external layer, the internal being kept warm both by its own heat and the heat of the body, so that the cooling will take place from without inward, and the contraction will take place toward the outer layer. As a consequence of this fact, the bandages should be applied with the firmness which it is necessary to maintain. If any doubt remains regarding the amount of pressure exercised, the surgeon will be able in a few minutes to see the result of the pressure on the extremity of the limb.

The hands of the surgeon will get smeared with paraffin, but this can easily be removed by washing them in hot water. Before touching the melted paraffin, if he rubs his hands over with glycerine, the paraffin will not adhere in the same way. A piece of India rubber sheeting or a newspaper should be placed under the limb to catch any drops of paraffin which may fall. If the paraffin is allowed to cool, it will then scale off from these articles, and very cleanly so from the India rubber sheeting. If any drops fall on the clothing, they will brush off if allowed to dry, or if the article be placed in hot water the paraffin when melted will rise to the top of the water. All scraps of paraffin may be collected and kept for future use. When the splint is of no further use, it may easily be removed by cutting it off with a sharp knife or a strong pair of scissors. If it be on a limb, it can be immersed in hot water, and when it becomes pliable it may be easily removed. After it has been taken off the limb, the bandage should be plunged into hot water—boiling water—when the paraffin will rise to the top and float, while the bandages and any dirt which may be on the paraffin will fall to the bottom. The dish should be permitted to stand until the water cools, when the paraffin may be removed in shape of a solid cake. It is thus ready for use a second time. In this way it may be used again and again.

Not only is it of use for ordinary splints, but it may be formed into any conceivable shape. Sayre's ideas regarding spinal bandages may be admirably carried out in paraffin. After the bandage has been applied during suspension, the jacket may be cut up the side, holes punched in it, and the apparatus may then be taken off and put on at pleasure, it being laced like a pair of stays. It may be taken off at night, if that be desirable, and it permits of the performance of the ordinary ablutions which add greatly to the patient's comfort. If in any case it is necessary to make the inside of a splint impervious to moisture, a mould of the limb ought first to be taken by applying the paraffin bandage in the usual way, then cutting it up, and brushing the inside and cut margins with paraffin. Such a splint will then resist the imbibition of discharges, and the wounds in the limb may be syringed out without detriment to the splint.

To summarize: Paraffin, as a material for the formation of splints, possesses the following advantages: 1. It is always ready for use. It may be kept for any length of time without spoiling or undergoing change, unless it is exposed to heat. 2. It is easy of application, requiring no special training or dexterity, and it may be ready for the surgeon about fifteen minutes after he has ordered it. 3. It sets readily, and yet not too soon. Starch and glue take a much longer time to harden, glass longer still, while plaster of Paris sets too quickly for many purposes. 4. Before it sets it may be cut with a pair of scissors and afterward with a sharp knife. 5. It may be made into a splint quite impervious to discharge or moisture of any kind. 6. It is light, easy, and comfortable to the patient. 7. It may be formed into a semi-elastic bandage, or a firm solid splint. 8. It may be used many times. After one splint is finished the paraffin can be remelted and reapplied.

Regarding its defects, the one usually spoken of is its liability to ignite. This fear is founded on the idea people entertain of the inflammability of paraffin oil, but block paraffin has quite a different character. When pure, all the naphtha has been removed from it. A spark or a lighted match will not set it on fire. If it be thrown into the fire it will burn like grease, but the splint will not ignite from any ordinary circumstance. There is no likelihood of any atmospheric temperature in this country affecting splints made from paraffin having a melting point of 130° F.; and for use abroad a paraffin having even a higher melting point may be obtained. In melting the paraffin, if it be done in the way described, by boiling water, there can be no possibility of it igniting. As paraffin candles—which are not pure paraffin, however—are obtainable in most villages where pure block paraffin cannot readily be got, experiments were tried with "Young's silver paraffin candles," and they were found to make a firm splint, which might be used in an emergency.

Paraffin would make an excellent addition to the army surgical stores; it is light to carry, it is not easily injured or destroyed, it will float in water without damage, and can be formed into any kind of splint.—*Lancet.*

EXTEMPORIZED SPLINTS.

A Paris correspondent to an English journal writes: Surgeon Major J. H. Porter, Assistant Professor of Military Surgery at the Army Medical School of Netley, is very successful in this portion of the Exhibition with his extemporized splints made of telegraph wire and pieces of a newspaper or a soldier's tunic. The medical visitors to the Exhibition are very much pleased with these simple, neat and ingenious appliances. All that is requisite is a piece of telegraph wire, some cord, and a piece of cloth or paper, and a splint may be made which can be applied to the finger, the elbow, inside arm, outside arm, the leg, etc.

OUTLINES OF CHEMISTRY.

By Henry M. M'Intire, M.E.

METALS.

They are, with the exception of mercury, all solids, and have the power of reflecting light to a great degree, giving them what is called a metallic luster. They are all of them opaque to the light, the cause, perhaps, of their brilliant luster. The properties of ductility, or capability of being drawn out into wire, and of malleability, or capability of being shaped by a hammer, are possessed by quite a number of them. The specific gravities, melting points, volatility, hardness, brittleness, and tenacity vary very much with the different metals. They are better conductors of heat and electricity than the non-metals, and generally have a higher specific gravity.

They unite with each other to form what are called alloys, except when one of the metals is mercury, when the compound is called an amalgam.

In treating the metals, for convenience the following divisions shall be made:

1. The Metals of the Alkalies.—Potassium, sodium, lithium, cæsium, rubidium.

2. The Metals of the Alkaline Earths.—Barium, strontium, calcium.

3. The Metals of the Earths.—Aluminum, glucinum, zirconium, thoranium, yttrium, erbium, terbium, cerium, lanthanum, didymium.

4. The Magnesian Metals.—Magnesium, zinc, cadmium.

5. The Iron Metals.—Cobalt, nickel, uranium, iron, chromium, manganese.

6. Metals which yield Powerful Acids when their higher Oxides are combined with Water.—Tin, titanium, mobium, tantalum, molybdenum, tungsten, vanadium, arsenic, antimony, bismuth.

7. The Copper Metals.—Copper, lead, thallium.

8. The Noble Metals.—Mercury, silver, gold, platinum, palladium, rhodium, ruthenium, osmium, iridium.

Potassium (atomic weight, 39·1; symbol, K). Potassium was discovered in the year 1807, by Sir Humphry Davy. He separated it from the oxygen and hydrogen, which with it form potash, using for separating them a current of electricity. It receives its name from its oxide, potash (potash being known long before the metal was discovered and separated). It (potash) is so called from the words *pot* and *ashes*, because it was at one time prepared from wood *ashes*.

This discovery of his, that potash was not an element, as had long been supposed, marks an important era in modern chemistry. Potassium, when in a metallic state, is a brilliant, bluish-white metal. At ordinary temperatures it is almost wax-like, being easily cut with a knife. Its specific gravity is less than one, so that it is lighter than water. It has a very remarkable attraction for oxygen, but a minute's exposure of a piece of it to the air will be sufficient to cover it with a white coating of oxide; and if heated to a point of volatilization, it will burst into a flame, and burn quite violently. This property of potassium of uniting with oxygen, wherever it can find it, can be very prettily illustrated in a simple experiment. If a piece of metallic potassium be thrown upon water, its easy oxidizability is at once shown by its decomposing the water, taking the oxygen and half of the hydrogen, leaving the other half to escape ($H_2O+K=KHO+H$). This escaping hydrogen is ignited by the heat generated by the reaction, and some of the potassium being volatilized, the hydrogen burns with the beautiful "potassium" flame.

There are three well defined oxides of potassium, K_2O, K_2O_2, K_2O_4, of which the last two are of minor importance, and the first only not so on account of its forming potassium hydrate.

Potassium protoxide, K_2O, is very deliquescent, absorbing water upon the first opportunity, and forming potassium hydrate, KHO ($K_2O+H_2O=2KHO$), from which no amount of heat can again drive the water, but as potassium hydrate will answer every purpose of the peroxide, the hydrate is always made use of.

Potassium hydrate, potassium hydroxide, caustic potash (even called at one time *hydrate of potash*) (KHO), is a hard, white substance, absorbing moisture and carbonic anhydride from the air with great rapidity. It is a very powerful cautery, destroying the skin. It dissolves in half its weight of water, generating much heat. It decomposes the fixed oils, forming in the operation soap (that kind known as "soft soap"). There are several sulphides of potassium; two sulphates (the neutral and the acid); a nitrate, known as niter, an oxidizing agent, and a very important substance on account of its use in the manufacture of gunpowder, and in pyrotechny; the iodide and bromide, quite important, of course, in photography, and very useful in medicine; a chlorate, the "sore-throat stuff," quite important as an oxidizing agent, etc.; two carbonates (neutral and acid). The salts of potassium, with few exceptions, are colorless, or white; they are all soluble in water, the sulphate, perchlorate, tartrate, and platino-chloride, being the least so.

Sodium (atomic weight, 23; symbol, Na). Sodium was discovered by Sir Humphry Davy, immediately after his discovery of potassium, and separated by him in the same manner. It is named from its oxide soda, which in turn is derived from a Spanish word, the name of a plant, from the ashes of which much soda was once prepared. In its metallic state it is of a bluish-white color, soft; indeed it much resembles potassium in many respects. The same reaction takes place with sodium as with potassium when it is thrown upon water, with the exception that if the water be cold, the heat generated will not be sufficient to ignite the liberated hydrogen. If, however, the water has been previously heated, or has been thickened with starch, the hydrogen will burn, and, on account of the volatilized sodium, with the

"sodium" flame (which is one of the chief distinctions between sodium and potassium; potassium colors the flame purple, whereas sodium colors it yellow). Sodium compounds are very widely diffused (to a far greater extent than those of potassium). They exist very abundantly in sea water, and in many minerals and rocks. A particle of dust even contains it.

There are two oxides of sodium known, *Sodium oxide* (Na_2O), and *Sodium dioxide* (Na_2O_2). The latter is not much more than a chemical curiosity; the former, a white powder, is not made use of directly; it takes up water, however, with great rapidity, forming

Sodium hydroxide, sodium hydrate, or *caustic soda* (NaHO). From this the water cannot again be driven by heat. It resembles to a very great extent potassium hydrate, although it is not as volatile. As for other properties, they are so much alike that the description of the one answers for the other; sodium hydrate, however, makes "hard" soap, in soap-making. It is also much cheaper than potassium hydrate, and is accordingly used in preference to the potassium compound, when a preference can be made.

Sodium chloride (common salt) (NaCl) is a most important salt of sodium, one of such everyday use, however, that it will require no description. It is not only of value as salt (with its thousand-and-one uses), but also for the preparation of other sodium compounds.

As for the remaining salts of sodium, the mention made previously of like salts of potassium would almost serve. There are two carbonates, the neutral and bicarbonate; two sulphates, the neutral being known by the name of glauber salts; a hyposulphite; a biborate, which has been described, and so on through the whole catalogue.

LITHIUM (atomic weight, 7; symbol, Li). Lithium was discovered by Sir Humphry Davy, soon after his discovery of potassinm and sodium, and by the same means. It was so named from a Greek word, meaning a "stone," because at first it was found only in the mineral kingdom. At one time, it was supposed to be of but rare occurrence; but later investigations have proved that, although in very small quantities, it is still quite widely distributed, being found in many springs, in tobacco, in milk, and even in the human blood. Like sodium and potassium, it has its characteristic flame. The "lithium" flame is of a most beautiful crimson color Lithium is the lightest metal known.

RUBIDIUM (atomic weight, 85·4; symbol, Rb). Rubidium was discovered in 1860, by Bunsen and Kirchhoff, by means of spectrum analysis. Its name is derived from the Latin, and means "dark red;" so called from some of the lines produced by it in the spectroscope. It occurs in a few minerals, some mineral springs, and sometimes, in very slight traces, in beet-root, in tobacco, in coffee, in grapes, and in other plants.

CÆSIUM (atomic weight, 133; symbol, Cs). This metal was discovered by Bunsen and Kirchhoff at the same time and by the same means as rubidium. It was so named from a Latin word, meaning "sky-blue," referring to the color of the lines in the spectroscope. It is so much like rubidium, and the two are so very much like potassium, that they had never been separated from that metal, or even known to exist in connection with it, till the spectroscope announced the fact.

AMMONIUM (molecular weight = 18; formula, NH_4). From studying the ways the various salts of ammonium are built up, the conclusion has been arrived at that there is a metal, NH_4, ammonium. This conclusion is only theoretical (very plausible, however), as no such metal has ever been obtained. It is supposed, though, that there is an amalgam of it with mercury, but some are skeptical enough to doubt this; that is, not to doubt the existence of a certain substance that seems evidently to be ammonium amalgam (for it is easily prepared), but the assertion that this is a compound of the metal ammonium and mercury. Whether there be such a metal or not, there is no objection to supposing one such. According to all its characteristics, it would be classified under the head of the alkaline metals. Its salts resemble those of the other alkalies very much; they are all of them volatile, however; most of them volatilizing without change.

The metals of the alkalies resemble each other very much in many particulars. Sodium, whose properties are intermediate between those of potassium and lithium, has for its atomic weight a number which is a mean between those of potassium and lithium. After the same manner, rubidium is related to potassium and cæsium. They are all monivalent; they are all soft, easily fusible, volatile at high temperatures; they all decompose water with the evolution of hydrogen. They are very easily oxidized, forming basic oxides, which have a great attraction for water, forming with it hydrates, very alkaline and caustic, from which the water cannot be expelled by heat; having also a great affinity for carbonic anhydride (CO_2).

We come next to the metals of the alkaline earths.

BARIUM (atomic weight, 137; symbol, Ba). Barium was first separated by Sir Humphry Davy, in the same manner as potassium. It received its name from the oxide baryta, and should have been named barytum. This latter name has been proposed, but too late to be of use. Baryta itself is derived from a Greek word, meaning heavy, because it is the heaviest of the earths. It has been separated as a metallic powder. It decomposes water at all temperatures, is easily oxidized in the air, tarnishing almost immediately upon exposure.

It forms two oxides, *Barium protoxide,* or *baryta* (BaO), and *barium peroxide* (BaO_2). The first is the only one that forms salts; the other is but of slight importance. Baryta unites easily with water, forming the hydrate BaH_2O_2; not very soluble in cold water, but quite so in hot.

There are many other salts of barium, but hardly of enough relative importance to be mentioned here. The "barium" flame is of a yellow-green color.

STRONTIUM (atomic weight, 87·5; symbol, Sr). Strontium was separated in the metallic form in the same way as barium and the alkalies. It is named from its oxide, strontia, or strontian (called thus from Strontian, a place in England, where it was first found). It decomposes water at all temperatures, and much resembles barium. It is a malleable metal of a pale-yellow color. The "strontium" flame is of a beautiful crimson color. There is but one oxide:

Strontium oxide, strontia, or *strontian* (SrO). Strontium nitrate is much used in pyrotechny, for the beautiful color it imparts to the flame, more than the other salts of strontium.

CALCIUM (atomic weight, 40; symbol, Ca) was obtained in a metallic state by Sir Humphry Davy, in the same way as the alkalies, etc. It is so named from the Latin term for lime. It is of a light yellow color, and is very malleable. It decomposes water, and is very easily oxidized under all circumstances. It has but one oxide:

Calcium oxide or *lime* (CaO), is obtained by heating or "burning" the carbonate, the purity of the lime depending on the purity of the carbonate used, of course, and the carbonate occurs in nature in all stages of purity. The quick, or caustic, lime, used for building purposes, is manufactured from limestone, and is sufficiently pure. Pure lime is very infusible; the oxyhydrogen flame fails to attack it; it, however, renders it very incandescent. This property is utilized in the oxyhydrogen light (an invention of the late Dr. Hare, of Philadelphia. The honor of the invention was claimed by an Englishman, a Lieutenant Drummond, of the British Navy, and although there were no foundations for his claims, the light often goes by the name of the Drummond light). Lime has a great attraction for water, uniting with it readily and with great heat, forming a white powder called calcium hydrate, or slack lime (CaH_2O_2).

This hydrate has a great attraction for carbonic anhydride (CO_2), to which fact is partly due the hardening of mortar, the lime absorbing carbonic anhydride, and being changed into the carbonate. The lime also unites with the silica of the sand in the mortar, forming an insoluble silicate.

Calcium carbonate, or *carbonate of lime* ($CaCO_3$), occurs extensively in nature; as limestone, marble, coral, chalk, calc, or Iceland spar, and some other minerals. It is insoluble in pure water, but dissolves quite freely in water containing carbonic acid. Water containing it thus dissolved is temporarily "hard." Boiling will drive off the carbonic acid, and the calcium carbonate will separate out; or it may be made "soft" in other ways.

Calcium sulphate, or *sulphate of lime* ($CaSO_4$), occurs in nature as gypsum and alabaster, which contain two molecules of water of crystallization. When these are driven off, plaster of Paris is formed. It is quite insoluble in water. Water containing a trace of it becomes permanently "hard," not being able to be changed by boiling. Many of the other salts of calcium are common, and very useful.

The three metals of the alkaline earths are divalent. They all decompose water quite readily. Their carbonates are insoluble in water, but soluble in water containing carbonic acid.—*Philadelphia Photographer.*

CHEMICAL ACTION.

"DISSOCIATION, or Modern Ideas of Chemical Action," was the subject of a lecture lately delivered in London by Prof. Dewar.

New chemistry and old were now so distinct, said Prof. Dewar, that it was for some years quite customary to refer to them, as it were, to two different times, and this had been mainly brought about by the large advances which had recently been made in organic chemistry. His object was to deal with some of the large generalities that had been elaborated through a long process of time, and to show that the advantage of the long experiments which were apparently of little use at the time was that in the cumulative result they were of much greater value than sudden and brilliant discoveries. For this purpose he must direct attention for a moment to chemistry at the beginning of the century.

THE FATHER OF MODERN CHEMISTRY.

Black died in 1799, and they justly regarded him as the father of modern chemistry. He was so rigid a teacher that though he started the new chemistry with Lavoisier in his last days, he still strongly objected during 30 years of his professional career to regard any doctrine of chemistry as final at his time, and the consequence was distinctly stated that he never called his lectures lectures on chemistry, but lectures on the action of heat and matter. It had been a matter of very great difficulty to chemists to understand how at that period Black managed to lay so firm and secure a basis in such a difficult department of science.

The great discovery of Black was the production or origin of fixed air, associated with the transformation of bodies where they were liquefied or became gaseous—the great doctrine of latent heat—that a body in passing from a solid into a liquid took in heat which was not measurable by the thermometer. At the beginning of the century it was distinctly regarded as proved that air was really a substance that differed from the fluid in some way or other, having stored into it a certain quantity of heat.

In a few years they found Dalton commencing to say, and stating distinctly in 1805, that he had no doubt that the permanent gases were liquefiable bodies. He said at the time that the experiments of Black and others had so far proved the results that there could scarcely be entertained any doubt respecting the reducibility of elastic fluids of whatever kind into liquids, and that we ought not to despair of effecting it by the use of low temperatures and strong pressures exerted on unmixed gases.

EXPERIMENTS SHOWING THE PRESSURE OF VAPORS.

Now, in order to illustrate what Dalton really did, he (Prof. Dewar) would begin by proving that all liquids in a gaseous state had a certain amount of vapor, and that the vapor exerted a certain pressure, which was measurable. He had on the table three ordinary barometers, and into two of these he would introduce two fluids, leaving the third as a standard. Into the first he would introduce at the top a little alcohol, and into the little cup at the top of the second some ether. They would observe that the alcohol floated about on the surface of the mercury, and that the mercury was being depressed—that depression being produced by the vapor of the fluid. Different fluids had different amounts of pressure. Ether had an enormous pressure, and it would be observed that it forced the mercurial level down much lower than the alcohol did. Dalton's investigation as to the pressure of vapors could only be regarded as second to his great discovery of the atomic theory, for it directed the attention of investigators to the laws relating to the pressure of vapor and temperature.

EXPERIMENTS WITH CARBONIC ACID.

Now, in order to show better what he had been explaining he would magnify through a lens fixed air—carbonic acid, discovered by Black—and then subject it to pressure. As the pressure was put on, the manometer hand rose, and they would see the liquid carbonic acid appear as a clear liquid on the surface of the mercury. This carbonic acid was as permanent as water, provided it was at the required pressure, which was something more than 60 atmospheres—900 lbs. to the square inch. The pressure would fall as he reduced the temperature, and by compressing it again it would rise again temporarily.

He would show them that this liquid could be made to boil. The appearance of this liquid carbonic acid was, as illustrated, entirely altered by altering the temperature. This was typical of all fluids, and indeed of all solids. He also showed how the fluid could be made to disappear by increasing the temperature, notwithstanding that he increased the pressure ever so much. Even if he subjected it to the pressure of 100 atmospheres—1,500 lbs. per square inch—the liquid would not appear.

Arranging a current of vapor to gradually heat the glass, in a short time they would see the fluid gradually disappear although he kept increasing the pressure to keep up the volume.

THE CRITICAL POINT.

This had been most elaborately worked out by one of the greatest discoverers of the time—by Dr. Andrews, of Belfast—namely, what he called the "critical point"—and he was only sorry that Dr. Andrews was not present to see magnified, and on so large a scale, an experiment which he had often shown him on a smaller one. At 80° this fluid optically disappeared, and no amount of pressure would at that temperature bring it back. But by cooling it again they would get back the liquid, though there was then no liquid there, apparently. This was exactly parallel to what went on with a large number of gases.

FIRE AND WATER.

The effect of pressure in modifying chemical bodies dates from the beginning of the century, being observed very shortly after the time of Black. In fact, Black had a very favorite pupil in Hutton, the great geologist. At that time it was a source of great discussion among geologists and physicists how far water or fire played the greatest part in the actions that had taken place in the past. One school argued that water had done everything, the other that fire did everything. Hutton supported the doctrine that fire modified the character of the stratified rocks, and he answered the objections raised to the stability of certain chemical bodies by proposing the theory that pressure under the ocean produced a modifying influence on chemical changes. His disciples were taught this, but never attempted any experimental verification, with the exception of Sir James Hall, who made a very interesting experiment, about 1798, on the character of basalt when fused. He showed that if they fused basalt it could be reproduced, provided sufficient time was given for it to cool.

After Hutton's death Sir James Hall made an elaborate series of experiments to prove that Hutton's theory was right. The substance he took was carbonate of lime. How was it that in an ordinary limekiln caustic lime was obtained and carbonate of lime did not exist? How was it that carbonate of lime was obtained at all, if fire had acted, as was said, in geologic states?

STABILITY DEPENDS ON PRESSURE.

Hall tried to prove that stability depended upon pressure, and succeeded in producing chalks and actual marble by confining the marble or chalk in an enormous tube of great length, heating it to a high temperature, and preventing the escape of anything; so that chalk, or a species of marble, was formed by heating carbonate of lime. Fifty or a hundred atmospheres were sufficient to produce a chalk of very little weight, and, therefore, large deposits of lime could be had without its being necessarily caustic. About 500 of such experiments had been greatly lost sight of. Little had been done, and a repetition of this experiment in a different form was one made within the last twelve or fifteen years. The principle was one which he would illustrate. The lecturer then gave an elaborate chemical illustration of the experiment referred to.

The great development of the effect of pressure in modifying chemical bodies was due to Prof. Clair Deville of Paris, who for the last twenty years had rigidly followed the philosophy of Black in examining the action of heat on chemical bodies or mixture of bodies. In other words, he had compared a vapor most rigidly with the behavior of a chemical body, and all the experiments of Deville were really related to a very ingenious experiment of Mr Justice Groves, who found that water, although a very stable fluid, was readily decomposed at a white heat by means of red hot platinum.

This struck Deville as an extraordinary experiment, because here they had highly heated steam giving such a temperature as to decompose water itself, and by experiment he found that all that water required for its decomposition was that they should have a continuous current of vapor driving away the amount decomposed. This was exactly parallel to the decomposition of chalk.

INTERESTING EXPERIMENTS.

The experiment was then made, and showed that at a temperature very much lower than the fusing point of platinum, water was decomposed into gases, and that this was so was shown by reproducing water from the gas by the aid of the electric spark.

Another very interesting experiment was made, showing the results of boiling action set up among the crystals of carbonate of potash, as also another experiment with palladium with the same object. Every vapor has a certain curve that represents all its relations—namely, the increase or diminution of pressure to the temperature.

If it was true that the behavior of a chemical body was so strictly analogous to that of a vapor, then all the laws of dynamics could be applied to the stability of chemical bodies. This had modified entirely all previous ideas of metallurgic interactions, and it has enabled chemists to ascertain temperatures very much beyond the range of the best thermometers, to consider carefully the case of high temperatures as they occurred in the sun, and to explain a great many abnormal reactions that chemists had never before been able to explain.

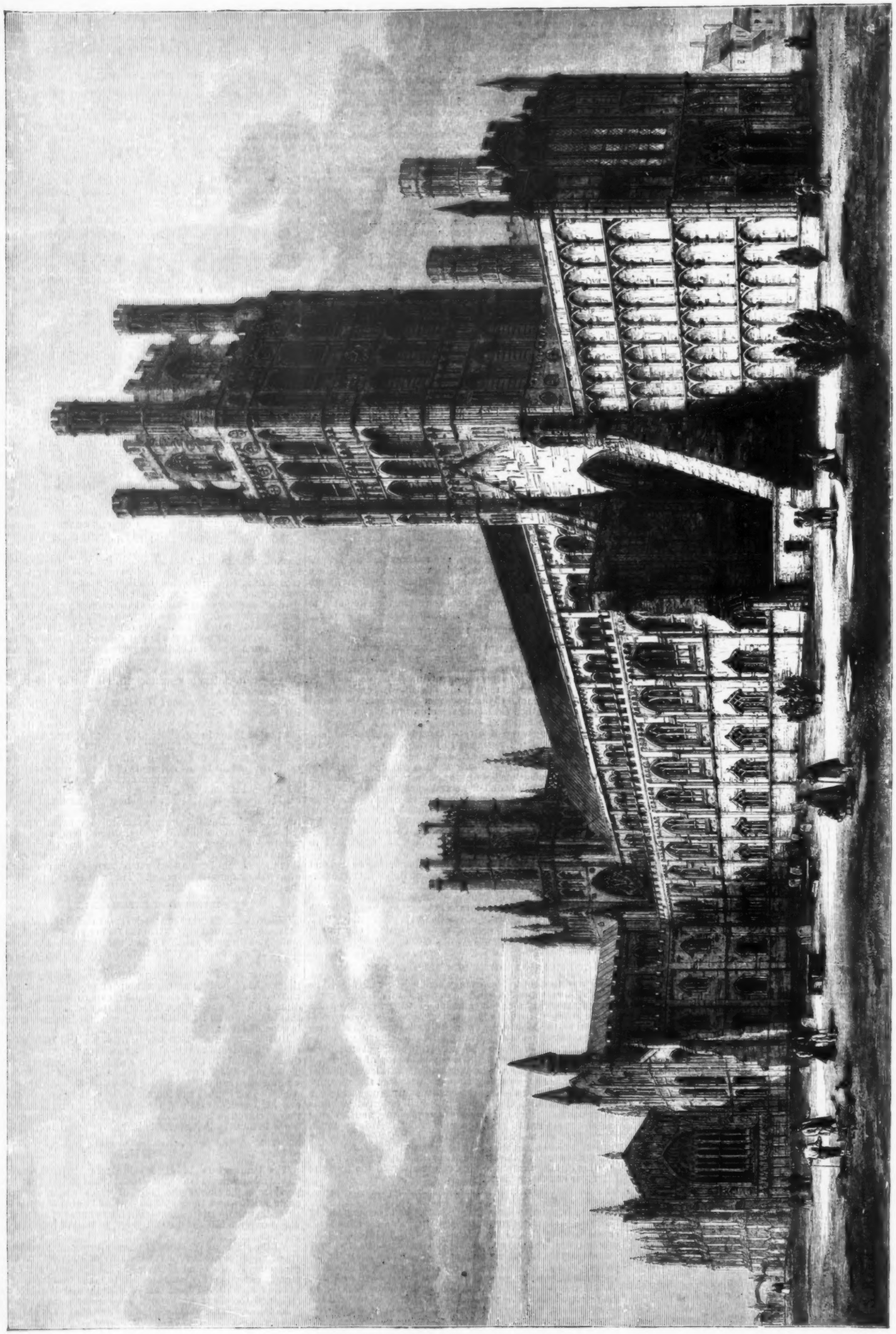
DISSOCIATION.

The temperature in dissociation was that temperature where a body could not exist—that is, that it was that temperature in the case of the body of water where no water could exist, where there was no possibility of producing water at that temperature; that was a temperature of something like between 3,000 and 4,000 degrees, instead of being 30 degrees.

All the elaborate relations of temperature and pressure of vapor might be applied to the stability of chemical bodies; consequently, the range of their knowledge had been enormously extended. It might appear to many that the case of a solid body differed from that of a fluid, and it might be imagined there was no parallel between the gas given off from the carbonate of lime or potash and that of water.

(To be Continued).

BACTERIA are not destroyed even by a temperature of 125·5° Fahr., or 157° degrees below the freezing point.



ELY CATHEDRAL, ENGLAND. ERECTED A. D. 1003–1342.

ELY CATHEDRAL, ENGLAND.

OUR engraving opposite is a view of the Cathedral of Ely, which was lately visited by the British Archæological Association during their late Congress at Wisbech. Ely, a city of eight or nine thousand people, and a Bishop's see, is about seventy miles from London, sixteen beyond Cambridge, and twenty-seven from the sea at Lynn Regis. It is the capital of the district called the Isle of Ely, which comprises the northern part of Cambridgeshire, and which formerly was rather a group of small islands, a sort of inland archipelago, surrounded or interspersed with lakes and fens, than a single island of that name. We refer to the valuable new book mentioned in our last, "The Fen-Land," by Messrs. S. H. Miller and Sydney Skertchly, for ample description and history of that remarkable district. Ely Cathedral occupies the site of a monastery founded in the year 673 by Princess Etheldreda (Audrey), daughter of a King of the East Angles, and widow first of Tonbert, the Saxon Prince of the South Fens, secondly of Egfrid, King of Northumberland. She endowed her convent, both of monks and nuns, with all the lands of the Isle of Ely, bequeathed to her by her first husband. After the Norman Conquest, the party of English, led by Hereward, still standing in arms against the Conqueror, made their Camp of Refuge in this neighborhood, trusting to its natural defenses of marsh and mere. King William I. appointed a relative of his own, Simeon, Prior of Winchester, to be Abbot of Ely, by whom, in 1083, the building of the oldest, or Norman, part of the existing church was begun, and this was carried on by Abbot Richard, son of the Earl of Clare.

Under King Henry I. the Abbey was converted into an Episcopal see, which was erected in 1109, its first occupant being Bishop Hervé Le Breton, translated from the diocese of Bangor. Among the succeeding Bishops were several men of mark: Bishop Nigel, nephew to the powerful Bishop Roger of Salisbury, and Lord High Treasurer of the Kingdom; Bishop William Longchamp, Chancellor and Grand Justiciary under Richard I., and the stout opponent of John; Bishop Eustace, who took an active part in John's dispute with the Barons; Bishop Hotham, Lord Chancellor in the reign of Edward II.; and one of still greater eminence, Bishop Morton, who was the chief agent in overthrowing Richard III. and bringing in Henry Tudor, and who became Archbishop of Canterbury. Since the Reformation, likewise, the see of Ely has been held by several distinguished Churchmen.

The Cathedral is well described in a neat "Handbook" published by Messrs. T. A. Hills & Son, Minster Place, Ely, the tenth edition of which was issued last year. There is a more elaborate treatise, "The Architectural History of Ely Cathedral," by the Rev. D. J. Stewart, Minor Canon, and one of older date, by the Rev. James Bentham. Upon the occasion, in October, 1873, of the bis-sexcentenary celebration of Etheldreda's foundation of Ely Abbey, Dean Merivale compiled a memorial volume (also published by Messrs. T. A. Hills & Son), which contains all the speeches, lectures, sermons, and other addresses delivered at that festival, with a full report of the proceedings, and an account of the works for the restoration of the sacred building. Sir Gilbert Scott's lecture upon its architectural characteristics may here be consulted with advantage.

The view drawn by our artist, Mr. S. Read, is taken from

SUGGESTIONS IN DECORATIVE ART.—IRON GRILLE FOR DOOR HEAD; ALSO, PORTION OF SCREEN, CHAPEL, S. ANASTASIA, VERONA.—*From the Workshop.*

the northwest, showing the gap left by the fall of the north transept tower, at what date is not certainly known. The corresponding transept tower on the south side is seen, to the right hand of the great tower, rising above the roof of the west front. In the eastward part of the building a beautiful octagonal structure, of moderate height, marks the junction of the nave with the choir, here crossed by the great transept, which is chiefly Norman, and the most ancient portion of the Cathedral. To the left hand in our view, and thus situated, not as usual, east of the choir, but parallel with the choir on its north side, is the Lady Chapel, which was originally the shrine of St. Etheldreda. The entire length of the Cathedral is 565 feet, which is greater than that of any other Gothic church in Europe; and if the Lady Chapel were in the ordinary position, behind the choir, the whole edifice would be 100 feet longer. The nave, 203 feet long, 72 feet 6 inches wide, including the aisles, and 72 feet high, is of late Norman construction. Its ceiling has recently been adorned with a series of paintings on wood, representing Bible history subjects, by two accomplished amateurs, the late Mr. Styleman Le Strange, of Hunstanton, and Mr. Gambier Parry. The great tower, and also the two transept towers near the west end, were probably built by Bishop Geoffrey Riddell in the latter part of the twelfth century; but the upper turrets are of Perpendicular style. The noblest feature, however, of the whole Cathedral is the central octagonal structure, which was built in about twenty years, from 1321 to 1342, by Prior Alan, of Walsingham, in place of the old central tower of the Norman Abbot Simeon, which had suddenly fallen. The octagon is so arranged as to take in the entire breadth of the church, including the aisles, both of nave and choir; its interior presents four large and four smaller arches, with lofty clustered shafts to support a ribbed vaulting of timber, and the lantern above all. This is said to be unique in Gothic architecture. Part of the choir, and the Lady Chapel also, which is of unusual dimensions and very beautiful, are of the same period, the first half of the fourteenth century. There is, perhaps, no cathedral in Great Britain which displays more adequately the characteristics of different stages in the progress of ecclesiastical architecture than this Cathedral of Ely, the Queen of the East Anglian Fenland.—*Illustrated London News.*

SUGAR IN THE NECTAR OF FLOWERS.*

By Alex. S. Wilson, M.A., B.Sc.

Nectar is the term applied by botanists to the sweet-tasted fluid which is secreted within the cups of insect-fertilized flowers; and the object gained to the plant by its presence is that insects, induced to visit flowers for its sake, are useful to the plants by effecting a cross fertilization. Mr. Darwin has shown what an amount of additional vigor is thus conferred on the seeds which subsequently result in contrast with the evil effects produced by continuous inbreeding. In many instances this sweet liquid is exuded from special glands, but in other cases from portions of the flower that do not seem to have been specially adapted for this purpose. Morphologically, nectaries may represent very different structures, but not unfrequently they are of the nature of an aborted organ—such as a petal or stamen.

It is a point in dispute among biologists whether this saccharine matter is a true secretion or simply an excretion of effete matter from the vegetable cells—a by-product of the chemical changes taking place within these cells. The latter view seems to be favored by the fact that a similar sweet-tasted fluid, much sought after by insects, is exuded on different parts of some plants quite unconnected with the flower, as in the laurel, brake fern, lime tree, acacia, etc. As to the use of such exudation of sweet liquid, various suggestions have been made by those who are disposed to regard it as a true secretion; as, for instance, that it serves as an attraction to certain insects to frequent the plant, these insects rendering service by keeping off animals to whose attacks the plant may be subject. Probably this is to some extent true, but it cannot be said to hold universally. Nectar is of course the source whence the bee derives honey, but it also affords food to many kinds of insects which do not possess the habit of storing up.

A division of the humming birds is named Melliphagi on account of living on this substance; but it is probable that in some cases the small insects seeking the nectar, and not the nectar itself, may be the object of the visits of these birds to nectar-producing flowers. The bright colors, as shown by Sir John Lubbock's experiments, serve to guide insects to the flowers, and the odors which they emit fulfill the same end. The markings on a flower's petals, it is to be noted, always converge toward the nectar, as in the violet. The importance of these guides to insects will be apparent from the following estimations, which show how indispensable it is that as little time as possible should be lost by an insect collecting honey. It must also be remembered that the nectar is usually contained in the most secure and best covered parts of the flower, the object being to prevent the access of rain, which, owing to the extreme solubility and diffusibility of sugar, would speedily cause it to be transferred to parts of the plants where insects could reach it without being of any service in the way of cross fertilization. The chief purpose of the flower would in this way be frustrated.

The formation of nectar is observed to take place most freely in hot weather, and to be prevented by cold or wet. So great economy is exercised by the plant that it is only formed at the time when insects' visits would be beneficial, *i. e.*, when the anthers are ripe and shedding their pollen, or when the stigma is matured and ready to receive pollen. By biologists the visits of bees, butterflies, and other insects are believed to have exercised in past time an important influence in modifying the size, shape, color, etc., of flowers, and the following experiments, in spite of their incompleteness, are of interest as showing to what an extent this action takes place in nature, and as helping to determine the value of this factor. These estimations are only the first of a series, and the writer regrets that he has been unable to give them the desirable completeness, but hopes to continue them.

The nectar was extracted with water, and the sugar determined before and after conversion by means of Fehling's copper solution. Many of the estimations were done in duplicate, and gave results that agreed perfectly. In the case of fuchsia—which is not deprived of its nectar by any insects in this country, the nectary being inaccessible to native species—we have probably the whole amount formed, but in the other cases the visits of bees, etc., may have reduced the amounts considerably. In this case it is a clear colorless liquid, having an acid reaction and an intensely sweet taste; that of many others has the strong characteristic odor of honey:

Sugar in Flowers.

	Total.	Fruit.	Cane? (as Fruit.)
	M.m.g.		
1. Fuchsia, per flower	7·59	1·69	5·9
2. *Claytonia alsinoides*, do.	0·413	0·175	0·238
3. Everlasting pea, do	9·93	8·33	1·60
4. Vetch (*Vicia cracca*), per raceme	3·16	3·15	0·01
5. Ditto, per single flower	0·158	0·158	—
6. Red clover, per head	7·93	5·95	1·98
7. Ditto, per floret	0·132	0·099	0·033
8. Monkshead, per flower	6·41	4·63	1·78

Approximately, then, 100 heads of clover yield 0·8 grm. sugar, or 125 give 1 grm., or 125,000 1 kilo. of sugar; and as each head contains about 60 florets, 125,000×60, that is, 7,500,000 distinct flower tubes must be sucked in order to obtain 1 kilo. sugar. Now as honey, roughly, may be said to contain 75 per cent. sugar, we have 1 kilogrm. equivalent to 5,600,000 flowers in round numbers, or, say, two and a half millions of visits for one pound of honey. This shows what an amazing amount of labor the bees must perform, for their industry would thus appear to be indispensable to their very existence. Another point worth notice in these results is the occurrence of what appears to be cane sugar, and that in the case of fuchsia in the proportion of nearly three-fourths of the whole. This is remarkable, as honey is usually supposed to contain no cane sugar, its presence being usually regarded as certain evidence of adulteration. The question therefore arises whether this change, which takes place while the sugar is in the possession of the bee, is due to the action of juices with which it comes in contact while in the honey-bag or expanded œsophagus of the insect, or whether the process of inversion goes on spontaneously, as may perhaps be the case.

* Read before the Chemical Section of the British Association, Dublin, 1878.

NOT THE EGYPTIAN LOTUS.

The Hartford correspondent of the Springfield *Journal* claims to be well acquainted with the Connecticut flower recently reported to be a stray Egyptian lotus, and says that the report is a mistake. We quote:

"Recently I visited the creek where it grows, and found few flowers, but buds in great abundance, yet it is worse than useless to gather these, as they never open (a fact gatherers will do well to remember) unless they are on the very eve of flowering when picked. I succeeded in getting a half dozen in this condition, of which one in full and glorious bloom is before me at this writing. The real name of the flower, which is similar to but *not* the Egyptian lotus, is the yellow nelumbo or water chinquepin, and it is thus described in Gray's Botany: 'Corolla pale yellow; anthers tipped with a slender hooked appendage; waters of the Western and Southern States; rare in the Middle States; introduced into the Delaware, below Philadelphia, Big Sodus Bay, Lake Ontario, and in the Connecticut near Lyme; perhaps introduced by the aborigines. Leaves 10–20 broad; flower 5'-8' in diameter. Tubers farinaceous. Seeds also eatable.' It is from this seed, known to the Indians as the nelumbium or sacred bean, that the flower takes its name. It is only once in seven years that it is found in profusion at Hadlyme, the number that flower annually being very small, and the number of people who seek them of late years being about in the same ratio to the flowers as the number of trout fishermen in Connecticut bear to the number of trout caught, *i. e.*, about 10 to 1. The leaves are if anything more interesting than the flowers, as they are very large, sometimes 18 or 19 inches in diameter, of a beautiful dark green, with a soft, velvety surface and tough, fibrous stem five or six feet long. From the center of the leaves little spokes radiate in every direction. The leaf is very strong and will bear a considerable weight as it floats upon the surface of the water. Unlike the common water lily the flowers do not float upon the water, but rise several inches above it. Their stems are similar to those of the leaves of the plant.

"The 'tradition' that the original seeds came from Egypt is new and probably false, as botanists generally hold that the first seeds were probably bird sown. It is true that so far all efforts to make the plant grow elsewhere have failed, but the cove that contains them is one of such rare beauty, and the flowers and leaves so curious, as to well repay a visit."

FRUIT CULTURE IN THE UNITED STATES.

Fruit culture is making rapid progress in the United States. According to recent official statements, the land appropriated to this branch of industry is 4,500,000 acres. Upon this there flourish 112,000,000 apple trees, 28,000,000 pear trees, 112,270,000 peach trees, and 141,260,000 grapevines. The total value of the fruit crop throughout the United States is set down at $138,216,700, an amount equal to half the value of the average wheat crop of the country. Toward that large sum apples are held to contribute $50,400,000, pears $14,130,000, peaches $46,135,000, grapes $2,118,000, strawberries $5,000,000, and other fruit $10,432,000.

THE MILK OF THE COW TREE.

As long ago as fifty years, while the now eminent chemist, Boussingault was taking part in the war for independence, in the ranks under Bolivar, he made some very interesting observations on the cow tree or *Palo de vaca* of the natives (*Brosimum galactodendron*), the juice of which almost exactly resembles milk, and is used for the same purpose in Guiana, where it is native. Some specimens of this tree exhibited this year in the Champ de Mars have enabled him to complete his studies on vegetable milk, and he has now presented the results of these to the French Academy. The cow tree is an evergreen belonging to the natural order *Urticaceæ* or nettleworts of botanists. It attains a height of from 50 to 75 feet, and is clothed with oblong, pointed, leathery, alternate leaves. In order to obtain its milky sap it is only necessary to make incisions in the bark, when it flows very copiously; this operation is called by the natives "milking the tree." Of this sap Humboldt, who first brought the tree to the notice of foreigners, writes: "We were assured that the negroes on the farm, who are in the habit of drinking large quantities of this vegetable milk, consider it as highly nutritive; an assertion which startled us the more, as almost all lactescent vegetable fluids are acrid, bitter, and more or less poisonous. Experience, however, proved to us during our residence at Barbula, that the virtues of the cow tree, or *Palo de vaca*, have not been exaggerated." The investigations of M. Boussingault go to confirm the same opinion. He states that he used it for several months with coffee and chocolate; it has much more consistency than cow's milk, and offers a feebly acid reaction. Exposed to the air it soon coagulates and forms a sort of cheese, containing a fatty matter (undoubtedly complex), melting at 50°, and very much like beeswax. Of this material M. Boussingault made candles of excellent quality. It also contains a nitrogenous substance, apparently albumen, and also sugar, salts of potassa, lime, magnesia, phosphates, and water. Although containing the same elements as cow's milk, it differs from the latter in its quantitative composition. On the contrary, it exhibits with cream the strictest analogy, as may be seen by the following figures: Cream of cow's milk contains in 100 parts—butter, 34; sugar, 4; phosphates, caseine, and albumen, 3·5; water, 58. The milk of the cow tree contains in 100 parts—butter, 33; sugar, 3; phosphates, caseine, and albumen, 4; water, 58.

In conclusion, M. Boussingault gives it as his opinion that the tree might be naturalized in Algeria; but he adds that this new vegetable recruit would be much more valuable on account of its wax than for its milk.

FRESH EGGS THE YEAR ROUND.

Make a hen comfortable and she will lay; if a laying breed, so much the better. It is with Biddy much as with Brindle: good treatment disposes to maternity—in the hen, to the greater production of eggs; in the cow, to the increased secretion of milk. How then are we to make the hen most comfortable? This depends upon circumstances, some situations being more favorable than others.

In winter there must be warmth as well as light. Windows will readily give entrance to the light of the sun and the reflection of the snow, but they should be made double, so as to secure warmth, and well fitted in, especially the outside sash. Keep firmly secured during the winter, and have ventilation elsewhere. Secure the sides and roof well against the cold. In no case permit a crowded condition of the fowls. The light will make it pleasant; the roominess will dispose to ease and freedom, the latter being a prominent element of the fowl which cannot be abridged much without harm, though the Asiatics are somewhat an exception to this, probably from their long habit of close quarters and petting in the thickly inhabited countries of the East, hence they are well calculated for our cities. Cleanliness and fresh air are a necessity. Ventilation and disinfectants are the means to secure them, the latter not lacking in variety to meet circumstances, among which dry air, secured by a cold stove, stands first, the stove also serving as a superior ventilator to carry off the heavy noxious air below. This for the more imposing structures. The windows, of course, are to be on the south side, and if the north side is secured by a rise of ground or the wall of another building, anything that effectually keeps out the cold, all the better. This for winter.

Summer requires a different thing, and largely the opposite. How to attain coolness instead of warmth must now be the study. Not only ventilation but shade is wanted. Trees are one of the greatest advantages—trees and plenty of fresh air. These can be obtained readily by movable buildings, which are somewhat in vogue, and which favor the other advantage of turning about the building, the south side with the windows now facing the north, and getting the morning and evening sun and shade the rest of the day. In the great majority of cases, however, this is not done and cannot be done in the cities, but is the best of all plans where practicable, as it is the most efficient means of securing cleanliness; also affording pasture and freshness for the fowls. Where the hen house is a fixture a temporary awning is a great help in securing relief from the heat.

These are mainly the principles that govern in keeping fowls successfully. As circumstances vary, so the means for carrying out the principles will also vary, so that every one must judge for himself what is best suited to his case, how most readily and cheaply he can conform to its requirements, for the man who has not aptitude enough for this is not likely to succeed after he is furnished with what is necessary. But with intelligence and prompt action success is always attainable, not so much at first as after experience has aided him. It is a trade, like all other business, which even the most capable must learn before they can realize its greatest advantages.

To carry out the true spirit of a successful hennery the keeper must be on good terms with his feathered family, and permit of no strange intrusions to frighten the fowls, for no frightened fowl will lay; all disturbance of whatever kind must be avoided, and kindness and good treatment exercised from earliest chickhood to the end. This makes a fowl at home, and eager, if a prolific breed, for propagation. If she now has a sufficiency, not an excess, of food, the necessary variety, so that she is satisfied, is strong but not fat, with pure water whenever she wants it, and some gravel to grind her food, also room enough in her quarters so that she does not feel confinement—in a word, if she is happy, she will lay. Avoid by all means an exclusive diet of corn. Let corn be one among several other grains, buckwheat leading. Scraps of meat or other animal food should occasionally be given, as well as green vegetable material, or in summer access to grass and a range in the fresh air. An occasional forage of this kind, say once a day, is of vast benefit and a pleasure to the fowl, as well as to the keeper who observes it.

But who will take all this trouble? The answer is, those who succeed. You cannot succeed if you treat your fowls indifferently, whatever the breed may be. There may be eggs, and sometimes quite abundant, but in the long run they will cost more than they are worth, and often do so in the start. However, a little judicious management goes a great way, only let it cover the more prominent points; but full success can only be obtained by observing all that relates to the well-being of the hens; then a family can possess itself of cheap and fresh eggs the year round.—*Utica Herald.*

Preservation of Wine.—Bogdan Hoff.—The author added to twelve bottles of turbid wine respectively a variety of substances, among which was aluminum phosphate to the extent of 1½ to one per cent. The bottles were then allowed to stand open from December 15 to April 14. The bottles containing this addition remained perfectly good, and tasted older by six years. The others were either covered with mould or had passed into the acetic fermentation. In the wine treated with phosphate of alumina the acidity had diminished.